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FILE 'HCAPLUS' ENTERED AT 10:30:36 ON 25 SEP 2007

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FILE COVERS 1907 - 25 Sep 2007 VOL 147 ISS 14

FILE LAST UPDATED: 24 Sep 2007 (20070924/ED)

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This file contains CAS Registry Numbers for easy and accurate substance identification.

=> d que 136

L1 167 SEA FILE=REGISTRY ABB=ON PLU=ON C4H10O2/MF  
L2 90 SEA FILE=REGISTRY ABB=ON PLU=ON L1 AND ?DIOL?/CNS  
L3 1 SEA FILE=REGISTRY ABB=ON PLU=ON BUTANEDIOL/CN  
L4 90 SEA FILE=REGISTRY ABB=ON PLU=ON L2 OR L3  
L5 23645 SEA FILE=REGISTRY ABB=ON PLU=ON (101021-58-3/CRN OR 101021-60-7/CRN OR 107-88-0/CRN OR 110-63-4/CRN OR 110-71-4/CRN OR 114794-46-6/CRN OR 117373-32-7/CRN OR 117373-33-8/CRN OR 119567-52-1/CRN OR 119567-53-2/CRN OR 127032-47-7/CRN OR 127032-49-9/CRN OR 136707-56-7/CRN OR 136779-42-5/CRN OR 138885-86-6/CRN OR 144831-21-0/CRN OR 14848-89-6/CRN OR 159806-32-3/CRN OR 160961-49-9/CRN OR 168011-04-9/CRN OR 179679-50-6/CRN OR 179913-51-0/CRN OR 19132-06-0/CRN OR 2163-42-0/CRN OR 219473-96-8/CRN OR 219473-97-9/CRN OR 219925-61-8/CRN OR 23554-34-9/CRN OR 24347-58-8/CRN OR 24621-61-2/CRN OR 25265-75-2/CRN OR 26466-25-1/CRN OR 286012-95-1/CRN OR 28795-91-7/CRN OR 287963-01-3/CRN OR 339267-04-8/CRN OR 339267-05-9/CRN OR 344328-83-2/CRN OR 344750-80-7/CRN OR 347841-77-4/CRN OR 36684-44-3/CRN OR 38274-25-8/CRN OR 39495-74-4/CRN OR 40348-66-1/CRN OR 41240-66-8/CRN OR 43044-32-2/CRN OR 495384-83-3/CRN OR 50410-66-7/CRN OR 513-85-9/CRN OR 5341-95-7/CRN OR 554429-16-2/CRN OR 558-43-0/CRN OR 584-03-2/CRN OR 58735-88-9/CRN OR 62064-81-7/CRN OR 6290-03-5/CRN OR 67057-67-4/CRN OR 67057-69-6/CRN OR 68344-06-9/CRN OR 68972-45-2/CRN OR 6982-25-8/CRN OR 70969-15-2/CRN OR 71760-76-4/CRN OR 71764-39-1/CRN OR 72271-58-0/CRN OR 73522-17-5/CRN OR 74829-49-5/CRN OR 75156-26-2/CRN OR 76490-88-5/CRN OR 79562-77-9/CRN OR 79562-82-6/CRN OR 79864-96-3/CRN OR 799775-81-8/CRN OR 80404-89-3/CRN OR 80902-18-7/CRN OR 84803-08-7/CRN OR 84803-09-8/CRN OR 84868-09-7/CRN OR 84868-10-0/CRN OR 86688-15-5/CRN OR 871313-10-9/CRN OR 87876-53-7/CRN OR 87876-58-2/CRN OR 87876-59-3/CRN OR 89268-43-9/CRN OR 91314-21-5/CRN OR 942519-61-1/CRN OR 97825-34-8/CRN OR 99441-00-6/CRN OR 99801-86-2/CRN) OR L4  
L6 2 SEA FILE=REGISTRY ABB=ON PLU=ON GBL/CN

L10 25 SEA FILE=REGISTRY ABB=ON PLU=ON (1344-28-1/BI OR 108-30-5/BI OR 109-99-9/BI OR 110-16-7/BI OR 1304-28-5/BI OR 1305-78-8/BI OR 1306-38-3/BI OR 1309-48-4/BI OR 1312-81-8/BI OR 1314-11-0/BI OR 1314-13-2/BI OR 1314-23-4/BI OR 1317-34-6/BI OR 1317-38-0/BI OR 1333-74-0/BI OR 13463-67-7/BI OR 14635-75-7/BI OR 25265-75-2/BI OR 67-66-3/BI OR 7440-44-0/BI OR 7631-86-9/BI OR 7732-18-5/BI OR 9016-00-6/BI OR 9052-19-1/BI OR 96-48-0/BI)

L11 1 SEA FILE=REGISTRY ABB=ON PLU=ON L10 AND L6

L12 314 SEA FILE=REGISTRY ABB=ON PLU=ON 96-48-0/CRN OR L11

L13 1 SEA FILE=REGISTRY ABB=ON PLU=ON TETRAHYDROFURAN/CN

L14 8024 SEA FILE=REGISTRY ABB=ON PLU=ON L13 OR 109-99-9/CRN

L15 353 SEA FILE=REGISTRY ABB=ON PLU=ON C4H8O/MF

L16 18 SEA FILE=REGISTRY ABB=ON PLU=ON L15 AND OC4/ES

L17 8063 SEA FILE=REGISTRY ABB=ON PLU=ON (109-99-9/CRN OR 120089-77-2/CRN OR 135008-66-1/CRN OR 153172-62-4/CRN OR 1693-74-9/CRN OR 20665-63-8/CRN OR 243855-45-0/CRN OR 2717-68-2/CRN OR 34475-13-3/CRN OR 68383-93-7/CRN OR 70969-13-0/CRN OR 758674-46-3/CRN OR 775273-86-4/CRN OR 87174-62-7/CRN OR 87174-63-8/CRN OR 87174-64-9/CRN OR 89268-44-0/CRN OR 97807-15-3/CRN) OR L16

L18 8063 SEA FILE=REGISTRY ABB=ON PLU=ON L17 OR L14

L20 521 SEA FILE=CAPLUS ABB=ON PLU=ON L5 AND L12 AND L18

L22 217 SEA FILE=CAPLUS ABB=ON PLU=ON L20 AND PREP+NT/RL

L23 54460 SEA FILE=HCAPLUS ABB=ON PLU=ON HYDROGENATION+PFT,NT/CT

L24 43408 SEA FILE=HCAPLUS ABB=ON PLU=ON HYDROGENATION CATALYSTS+PFT,NT/CT

L25 108 SEA FILE=HCAPLUS ABB=ON PLU=ON L22 AND ((L23 OR L24) OR ?HYDROGENAT?)

L26 9 SEA FILE=HCAPLUS ABB=ON PLU=ON L25 AND ?DISTIL?

L28 1 SEA FILE=REGISTRY ABB=ON PLU=ON "SUCCINIC ANHYDRIDE"/CN

L29 2034 SEA FILE=REGISTRY ABB=ON PLU=ON L28 OR 108-30-5/CRN

L30 36 SEA FILE=HCAPLUS ABB=ON PLU=ON L25 AND (L29 OR SUCCINIC ANHYDRID?)

L31 35 SEA FILE=HCAPLUS ABB=ON PLU=ON L30 AND ?CATAL?

L32 18 SEA FILE=HCAPLUS ABB=ON PLU=ON L25 AND ?REACTOR?

L33 15 SEA FILE=HCAPLUS ABB=ON PLU=ON L25 AND ?STREAM?

L34 2 SEA FILE=HCAPLUS ABB=ON PLU=ON L32 AND L33

L35 10 SEA FILE=HCAPLUS ABB=ON PLU=ON L31 AND (L32 OR L33)

L36 19 SEA FILE=HCAPLUS ABB=ON PLU=ON L26 OR L34 OR L35

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L36 ANSWER 1 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2006:795527 HCAPLUS Full-text

DOCUMENT NUMBER: 145:188707

TITLE: Method for controlling hydrogenation processes

INVENTOR(S): Weck, Alexander; Roesch, Markus; Windecker, Gunther; Heydrich, Gunnar; Pinkos, Rolf; Schubert, Olga; Harth, Klaus

PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 23pp.  
CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
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WO 2006082165      A1      20060810      WO 2006-EP50507      20060130  
 W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH,  
 CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD,  
 GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR,  
 KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX,  
 MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE,  
 SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,  
 VN, YU, ZA, ZM, ZW  
 RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE,  
 IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ,  
 CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH,  
 GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY,  
 KG, KZ, MD, RU, TJ, TM

DE 102005004604      A1      20060810      DE 2005-102005004604      20050201

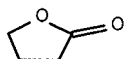
PRIORITY APPLN. INFO.:

DE 2005-102005004604A      20050201

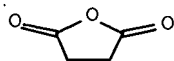
- AB In a method for controlling the hydrogenation of an alkene (e.g., maleic anhydride into succinic anhydride) in a hydrogenation reactor, the amount of hydrogen reacted during hydrogenation is determined first, whereupon the ratio between the amount of hydrogen reacted and the amount of alkene delivered is calculated, said ratio is compared to a predefined setpoint value, and finally at least one process parameter is modified if the ratio between the amount of hydrogen reacted and the amount of alkene delivered deviates from the predefined setpoint value by a given value. Process flow diagrams are presented.
- CC 27-6 (Heterocyclic Compounds (One Hetero Atom))  
 Section cross-reference(s): 21, 23, 35, 45, 48
- ST process control hydrogenation alkene; furandione prep maleic anhydride hydrogenation
- IT Hydrogenation  
 (apparatus; method for controlling hydrogenation processes)
- IT Anhydrides  
 RL: EPR (Engineering process); IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
 (cyclic; method for controlling hydrogenation processes)
- IT Carboxylic acids, reactions  
 RL: EPR (Engineering process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
 (dicarboxylic, unsatd.; method for controlling hydrogenation processes)
- IT Reactors  
 (hydrogenation; method for controlling hydrogenation processes)
- IT Hydrogenation  
 Process control  
 (method for controlling hydrogenation processes)
- IT Coolants  
 Heat exchangers  
 Heat transfer  
 Hydrogenation catalysts  
 (method for controlling hydrogenation processes using)
- IT Alkenes, reactions  
 RL: EPR (Engineering process); PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
 (method for controlling hydrogenation processes using)
- IT Temperature  
 (regulation; method for controlling hydrogenation processes using)
- IT Anhydrides  
 RL: EPR (Engineering process); PEP (Physical, engineering or chemical

process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(unsatd.; method for controlling hydrogenation processes  
using)

- IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-16-6,  
Rhodium, uses 7440-50-8, Copper, uses  
RL: CAT (Catalyst use); EPR (Engineering process); PEP (Physical,  
engineering or chemical process); PROC (Process); USES (Uses)  
(catalysts; method for controlling hydrogenation  
processes)
- IT 108-31-6, Maleic anhydride, reactions 110-16-7, Maleic acid, reactions  
RL: EPR (Engineering process); PEP (Physical, engineering or chemical  
process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(method for controlling hydrogenation processes)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 108-30-5P,  
Succinic anhydride, preparation 109-99-9P,  
Thf, preparation 110-15-6P, Succinic acid, preparation  
25265-75-2P, Butanediol 35296-72-1P, Butanol  
RL: IMF (Industrial manufacture); RCT (Reactant); SPN  
(Synthetic preparation); PREP (Preparation); RACT (Reactant  
or reagent)  
(method for controlling hydrogenation processes)
- IT 1333-74-0, Hydrogen, reactions  
RL: EPR (Engineering process); PEP (Physical, engineering or chemical  
process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(method for controlling hydrogenation processes using)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 108-30-5P,  
Succinic anhydride, preparation 109-99-9P,  
Thf, preparation 25265-75-2P, Butanediol  
RL: IMF (Industrial manufacture); RCT (Reactant); SPN  
(Synthetic preparation); PREP (Preparation); RACT (Reactant  
or reagent)  
(method for controlling hydrogenation processes)
- RN 96-48-0 HCAPLUS
- CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- RN 108-30-5 HCAPLUS
- CN 2,5-Furandione, dihydro- (CA INDEX NAME)



- RN 109-99-9 HCAPLUS
- CN Furan, tetrahydro- (CA INDEX NAME)



RN 25265-75-2 HCAPLUS  
CN Butanediol (CA INDEX NAME)

H<sub>3</sub>C-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>3</sub>

2 ( D1-OH )

REFERENCE COUNT: 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 2 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 2005:570881 HCAPLUS Full-text  
DOCUMENT NUMBER: 143:78656  
TITLE: Method for the production of defined mixtures of THF, butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivatives  
INVENTOR(S): Roesch, Markus; Pinkos, Rolf; Hesse, Michael; Schlitter, Stephan; Junicke, Henrik; Schubert, Olga; Weck, Alexander; Windecker, Gunther  
PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany  
SOURCE: PCT Int. Appl., 28 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: German  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

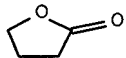
PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005058853	A2	20050630	WO 2004-EP13811	20041204
WO 2005058853	A3	20050804		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
DE 10357715	A1	20050714	DE 2003-10357715	20031209
EP 1694662	A2	20060830	EP 2004-803523	20041204
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, FI, RO, CY, TR, BG, CZ, EE, HU, PL, SK, IS				
CN 1890231	A	20070103	CN 2004-80036825	20041204
JP 2007516970	T	20070628	JP 2006-543447	20041204
US 2007135650	A1	20070614	US 2006-581074	20060531
PRIORITY APPLN. INFO.:			DE 2003-10357715	A 20031209

WO 2004-EP13811

W 20041204

- AB Mixts. of optionally alkyl-substituted THF, butanediol, and  $\gamma$ -butyrolactone are prepared by two-stage gas-phase hydrogenation where: (A) a gas flow of C4 dicarboxylic acids (e.g., maleic acid) and/or the derivs. is hydrogenated in a first stage in the gaseous phase on a catalyst at 200-300°/2-100 bars in a first reactor over a catalyst in the form of molded bodies with a volume of <20 mm<sup>3</sup> consisting of 5-95% Cu oxide and 5-95% of an oxide with acid centers in order to form a flow mainly consisting of optionally aryl-substituted  $\gamma$ -butyrolactone and THF; (B) succinic anhydride is separated by partial condensation; (C) THF, water, and  $\gamma$ -butyrolactone, which remain in the gaseous phase during the partial condensation, are hydrogenated at 150-240° at the same or lower pressure to reduce flow losses in the hydrogenation circuit in a second reactor over a catalyst of  $\geq 95\%$  CuO and 5-95% of  $\geq 1$  of ZnO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, CeO<sub>2</sub>, MgO, CaO, SrO, BaO, La<sub>2</sub>O<sub>3</sub>, and Mn<sub>2</sub>O<sub>3</sub> to form THF, butanediol and  $\gamma$ -butyrolactone; (D) hydrogen is separated from the products and recycled; and (E) the products are separated by distillation
- IC ICM C07D307-00  
ICS C07D307-32
- CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 45, 67
- ST THF butanediol butyrolactone hydrogenation manuf; maleic acid catalytic hydrogenation THF butanediol butyrolactone manuf
- IT Carboxylic acids, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(dicarboxylic, C4; method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT Distillation  
(in a method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT Hydrogenation  
Hydrogenation catalysts  
(method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT Monomers  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 7732-18-5P, Water, preparation  
RL: BYP (Byproduct); REM (Removal or disposal); PREP (Preparation); PROC (Process)  
(method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 1304-28-5, Baria, uses 1305-78-8, Calcia, uses 1306-38-3, Ceria, uses 1309-48-4, Magnesia, uses 1312-81-8, Dilanthanum trioxide 1314-11-0, Strontia, uses 1314-13-2, Zinc oxide, uses 1314-23-4, Zirconia, uses 1317-34-6, Dimanganese trioxide 1317-38-0, Copper oxide, uses 1344-28-1, Alumina, uses 7631-86-9, Silica, uses 13463-67-7, Titania, uses  
RL: CAT (Catalyst use); USES (Uses)  
(method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)

- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 25265-75-2P, Butanediol  
RL: IMF (Industrial manufacture); PEP (Physical, engineering or  
chemical process); PYP (Physical process); PREP (Preparation);  
PROC (Process)  
(method for the production of defined mixts. of THF and butanediol and  
 $\gamma$ -butyrolactone by catalytic gas-phase  
hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 108-30-5P, Succinic anhydride, preparation  
RL: IMF (Industrial manufacture); PEP (Physical, engineering or  
chemical process); PYP (Physical process); RCT (Reactant); PREP  
(Preparation); PROC (Process); RACT (Reactant or reagent)  
(method for the production of defined mixts. of THF and butanediol and  
 $\gamma$ -butyrolactone by catalytic gas-phase  
hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 1333-74-0, Hydrogen, reactions  
RL: PEP (Physical, engineering or chemical process); PYP (Physical  
process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(method for the production of defined mixts. of THF and butanediol and  
 $\gamma$ -butyrolactone by catalytic gas-phase  
hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 110-16-7, Maleic acid, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(method for the production of defined mixts. of THF and butanediol and  
 $\gamma$ -butyrolactone by catalytic gas-phase  
hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 25265-75-2P, Butanediol  
RL: IMF (Industrial manufacture); PEP (Physical, engineering or  
chemical process); PYP (Physical process); PREP (Preparation);  
PROC (Process)  
(method for the production of defined mixts. of THF and butanediol and  
 $\gamma$ -butyrolactone by catalytic gas-phase  
hydrogenation of C4 dicarboxylic acids and/or their derivs.)
- RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)

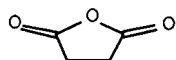


- RN 25265-75-2 HCAPLUS  
CN Butanediol (CA INDEX NAME)

H3C—CH2—CH2—CH3

2 ( D1—OH )

IT 108-30-5P, Succinic anhydride, preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PYP (Physical process); RCT (Reactant); PREP (Preparation); PROC (Process); RACT (Reactant or reagent)  
 (method for the production of defined mixts. of THF and butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.)  
 RN 108-30-5 HCAPLUS  
 CN 2,5-Furandione, dihydro- (CA INDEX NAME)



L36 ANSWER 3 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2005:493569 HCAPLUS Full-text  
 DOCUMENT NUMBER: 143:27030  
 TITLE: Homogeneous process for the hydrogenation of dicarboxylic acids and/or anhydrides  
 INVENTOR(S): Wood, Michael Anthony; Crabtree, Simon Peter; Tyers, Derek Vincent  
 PATENT ASSIGNEE(S): Davy Process Technology Limited, UK  
 SOURCE: PCT Int. Appl., 21 pp.  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005051875	A1	20050609	WO 2004-GB4397	20041015
W:	AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW			
RW:	BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG			
AU 2004293238	A1	20050609	AU 2004-293238	20041015
CA 2543854	A1	20050609	CA 2004-2543854	20041015
EP 1678108	A1	20060712	EP 2004-768927	20041015
R:	AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT,			



IE, SI, FI, RO, CY, TR, BG, CZ, EE, HU, PL, SK

CN 1871194	A	20061129	CN 2004-80031506	20041015
BR 2004016091	A	20070102	BR 2004-16091	20041015
JP 2007510638	T	20070426	JP 2006-537398	20041015
IN 2006DN02118	A	20070713	IN 2006-DN2118	20060419
MX 2006PA04893	A	20060720	MX 2006-PA4893	20060428
NO 2006002499	A	20060616	NO 2006-2499	20060531
US 2007142679	A1	20070621	US 2007-577340	20070123

PRIORITY APPLN. INFO.: GB 2003-25526 A 20031031  
WO 2004-GB4397 W 20041015

AB A homogeneous process is described for the hydrogenation of dicarboxylic acids and/or anhydrides in the presence of a catalyst comprising: (a) ruthenium, rhodium, iron, osmium or palladium; and (b) an organic phosphine. The hydrogenation is carried out in the presence of  $\geq 1\%$  water and at a pressure of 500-2000 psig and at 200-300° such that from about 1-10 mol of hydrogen are used to strip 1 mol of product from the reactor. Thus, maleic acid was hydrogenated into THF,  $\gamma$ -butyrolactone, and butanediol using a catalyst system of ruthenium trisacetylacetonate and 1,1,1-tris(diphenylphosphino)ethane.

IC ICM C07C029-149  
ICS C07C029-17; C07C031-20; C07D315-00; C07D307-08; B01J031-24

CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 27, 67

ST dicarboxylic acid catalytic hydrogenation; anhydride  
dicarboxylic catalytic hydrogenation; maleic acid  
catalytic hydrogenation manuf THF butyrolactone  
butanediol

IT Hydrogenation catalysts  
(Group VIIIB metal and phosphines; homogeneous process for  
hydrogenation of dicarboxylic acids and/or anhydrides)

IT Hydrogenation  
(apparatus; homogeneous process for hydrogenation of dicarboxylic  
acids and/or anhydrides)

IT Phosphines  
RL: CAT (Catalyst use); USES (Uses)  
(catalysts; homogeneous process for hydrogenation  
of dicarboxylic acids and/or anhydrides)

IT Anhydrides  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(cyclic; homogeneous process for hydrogenation of  
dicarboxylic acids and/or anhydrides)

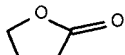
IT Carboxylic acids, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(dicarboxylic; homogeneous process for hydrogenation of  
dicarboxylic acids and/or anhydrides)

IT Hydrogenation  
(homogeneous process for hydrogenation of dicarboxylic acids  
and/or anhydrides)

IT Reactors  
(hydrogenation; homogeneous process for hydrogenation  
of dicarboxylic acids and/or anhydrides)

IT 594-09-2, Trimethylphosphine 603-35-0, Triphenylphosphine, uses  
1663-45-2 2622-14-2, Tricyclohexylphosphine 4731-53-7,  
Trioctylphosphine 6737-42-4 7439-89-6, Iron, uses 7440-04-2, Osmium,  
uses 7440-05-3, Palladium, uses 7440-16-6, Rhodium, uses 7440-18-8,  
Ruthenium, uses 7688-25-7 22031-12-5 22031-14-7 22031-20-5  
23582-02-7 23936-60-9 29149-93-7 65038-36-0 77609-83-7  
101069-25-4 117654-10-1 188566-43-0 227605-73-4 852954-74-6  
852954-75-7 852954-76-8  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst; homogeneous process for hydrogenation of

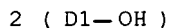
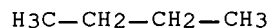
- dicarboxylic acids and/or anhydrides)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 25265-75-2P, Butanediol  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(homogeneous process for hydrogenation of dicarboxylic acids  
and/or anhydrides)
- IT 108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions  
110-16-7, Maleic acid, reactions 110-17-8, Fumaric acid, reactions  
1333-74-0, Hydrogen, reactions 155850-41-2  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(homogeneous process for hydrogenation of dicarboxylic acids  
and/or anhydrides)
- IT 108-30-5, Succinic anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(homogeneous process for the hydrogenation of dicarboxylic  
acids and/or anhydrides)
- IT 7732-18-5P, Water, preparation  
RL: BYP (Byproduct); NUU (Other use, unclassified); PREP  
(Preparation); USES (Uses)  
(solvent; homogeneous process for hydrogenation of  
dicarboxylic acids and/or anhydrides)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 25265-75-2P, Butanediol  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(homogeneous process for hydrogenation of dicarboxylic acids  
and/or anhydrides)
- RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



- RN 25265-75-2 HCAPLUS  
CN Butanediol (CA INDEX NAME)

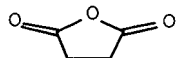


- IT 108-30-5, Succinic anhydride, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)  
(homogeneous process for the hydrogenation of dicarboxylic  
acids and/or anhydrides)

RN 108-30-5 HCAPLUS

CN 2,5-Furandione, dihydro- (CA INDEX NAME)



REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 4 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2002:233094 HCAPLUS Full-text

DOCUMENT NUMBER: 136:263083

TITLE: Method for hydrogenation of dicarboxylic  
acid

INVENTOR(S): Ishihara, Takeshi; Hamashima, Nagato; Kobayashi,  
Kenji; Ichiki, Tatsumi

PATENT ASSIGNEE(S): Tonen Chemical Corp., Japan

SOURCE: Jpn. Kokai Tokkyo Koho, 6 pp.

CODEN: JKXXAF

DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
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JP 2002088076	A	20020327	JP 2000-277911	20000913
PRIORITY APPLN. INFO.:			JP 2000-277911	20000913
OTHER SOURCE(S):	CASREACT	136:263083		

AB In hydrogenation of dicarboxylic acids, dicarboxylic anhydrides, or ester thereof using a palladium or rhenium-supported catalyst, the catalyst prepared by adhesion of rhenium compound on a support followed by heat treatment at 100-220° under reduction atmospheric is used. The catalyst support is preferably coal, coconut, or peat activated charcoal. The catalyst prepared above is able to sustain the conversion of dicarboxylic acids, e.g. maleic anhydride, into lactones and hydrogenation products, e.g.  $\gamma$ -butyrolactone, THF, and 1,4-butanediol, for a very long period time. Thus, 3.358 g Pd(NO<sub>3</sub>)<sub>2</sub> and 1.973 g Re<sub>2</sub>O<sub>7</sub> were dissolved in 6.72 g MeCN and 21.9 g H<sub>2</sub>O, diluted with distilled water to a total volume of 64 mmol, impregnated in 72 g coconut activated charcoal, stirred at room temperature for 4 h and at 120° for 5 h, and dried to give a catalyst precursor which was heated to 200° over 5 h under a stream of hydrogen and kept at the same temperature for 5 h, cooled to room temperature, completely purged with N<sub>2</sub>, and left to stand under a stream of N<sub>2</sub> containing 10% by volume oxygen until the exothermic reaction ceased to give 2% Pd-2.5% Re/activated coconut charcoal. Maleic anhydride was hydrogenated over 2% Pd-2.5% Re/activated coconut charcoal at 190-200° to give 97.2 and 96.1%  $\gamma$ -butyrolactone after 530 and 10.086 h of hydrogenation, resp.

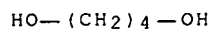
IC ICM C07D307-08

ICS B01J023-656; B01J037-18; C07C029-149; C07C031-20; C07D307-33;  
C07B061-00

CC 27-6 (Heterocyclic Compounds (One Hetero Atom))

ST hydrogenation dicarboxylic acid; rhenium palladium activated

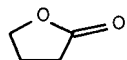
- charcoal supported catalyst hydrogenation
- IT Charcoal  
 RL: CAT (Catalyst use); USES (Uses)  
 (activated, coconut, coal, or peat; hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT Hydrogenation catalysts  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT Lactones  
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT 110-63-4P, 1,4-Butanediol, preparation  
 RL: BYP (Byproduct); PREP (Preparation)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT 7440-05-3D, Palladium, rhenium supported on activated charcoal  
 7440-15-5D, Rhenium, palladium supported on activated charcoal  
 RL: CAT (Catalyst use); USES (Uses)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Tetrahydrofuran, preparation  
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT 108-31-6, Maleic anhydride, reactions 10102-05-3, Palladium nitrate  
 12624-27-0, Rhenium oxide  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- IT 110-63-4P, 1,4-Butanediol, preparation  
 RL: BYP (Byproduct); PREP (Preparation)  
 (hydrogenation of dicarboxylic acids to lactones a hydrogenation products using palladium and rhenium supported on activated charcoal)
- RN 110-63-4 HCAPLUS  
 CN 1,4-Butanediol (CA INDEX NAME)



- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Tetrahydrofuran, preparation  
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
 (hydrogenation of dicarboxylic acids to lactones a

hydrogenation products using palladium and rhenium supported on  
activated charcoal)

RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



L36 ANSWER 5 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 2002:171834 HCAPLUS Full-text  
DOCUMENT NUMBER: 136:217182  
TITLE: Two-stage process for the hydrogenation of  
maleic acid into 1,4-butanediol or THF or  
gamma-butyrolactone  
INVENTOR(S): Hepfer, Robert P.; Miller, Craig T.; Attig, Thomas G.;  
Norenberg, Gregory A.; Budge, John R.  
PATENT ASSIGNEE(S): The Standard Oil Company, USA  
SOURCE: PCT Int. Appl., 14 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: English  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2002018316	A2	20020307	WO 2001-US26765	20010827
WO 2002018316	A3	20020620		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW				
RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
CA 2418280	A1	20020307	CA 2001-2418280	20010827
AU 200185320	A	20020313	AU 2001-85320	20010827
EP 1313693	A2	20030528	EP 2001-964473	20010827
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR				
JP 2004507516	T	20040311	JP 2002-523434	20010827
RU 2294920	C2	20070310	RU 2003-107041	20010827
TW 254040	B	20060501	TW 2001-90121162	20010828

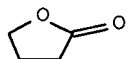
MX 2003PA01648	A	20040402	MX 2003-PA1648	20030224
US 2004039213	A1	20040226	US 2003-645429	20030821
US 6989455	B2	20060124		

## PRIORITY APPLN. INFO.:

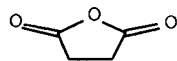
US 2000-651526	A	20000829
WO 2001-US26765	W	20010827

- AB At least one of gamma-butyrolactone, 1,4-butanediol, and THF are prepared in a process comprising: (A) a first hydrogenation zone and a second hydrogenation zone connected in series; (B) supplying to the first hydrogenation zone a feedstream comprising maleic acid; (C) reacting in the first hydrogenation zone, the maleic acid feedstock and hydrogen in contact with a catalyst to produce a reaction product comprising succinic acid; (D) supplying to the second hydrogenation zone, the reaction product of the first hydrogenation zone; (E) reacting in the second hydrogenation zone, the reaction product from the first hydrogenation zone and hydrogen in contact with a catalyst to produce a product stream comprising at least one of gamma-butyrolactone, 1,4-butanediol, and THF, where the temperature of the feedstream comprising maleic acid and the temperature of the first hydrogenation zone are controlled such that the temperature of maleic acid in the feedstream and the first hydrogenation zone does not exceed about 130°.
- IC ICM C07C051-36  
ICS C07C055-10; C07C029-149; C07C031-20
- CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 23, 27, 48
- ST butanediol manuf two stage hydrogenation maleic acid;  
dihydroxybutane manuf two stage hydrogenation maleic acid; THF  
manuf two stage hydrogenation maleic acid; butyrolactone manuf  
two stage hydrogenation maleic acid
- IT Hydrogenation catalysts  
(Pt-Group metals in a two-stage process for the hydrogenation  
of maleic acid into 1,4-butanediol)
- IT Platinum-group metals  
RL: CAT (Catalyst use); USES (Uses)  
(catalysts for the hydrogenation of maleic acid  
into 1,4-butanediol)
- IT Hydrogenation  
(two-stage process for the hydrogenation of maleic acid into  
1,4-butanediol)
- IT 7440-05-3, Palladium, uses 7440-06-4, Platinum, uses 7440-15-5,  
Rhenium, uses 7440-16-6, Rhodium, uses 7440-18-8, Ruthenium, uses  
7440-22-4, Silver, uses  
RL: CAT (Catalyst use); USES (Uses)  
(catalysts in a two-stage process for the  
hydrogenation of maleic acid into 1,4-butanediol)
- IT 7440-44-0, Carbon, uses  
RL: CAT (Catalyst use); USES (Uses)  
(support; catalysts in a two-stage process for the  
hydrogenation of maleic acid into 1,4-butanediol)
- IT 110-16-7P, Maleic acid, preparation  
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)  
(two-stage process for the hydrogenation of maleic acid into  
1,4-butanediol)
- IT 96-48-0P,  $\gamma$ -Butyrolactone  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)  
(two-stage process for the hydrogenation of maleic acid into  
1,4-butanediol or THF or)
- IT 110-15-6P, Succinic acid, preparation  
RL: PNU (Preparation, unclassified); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)

- (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)
- IT 108-30-5, Succinic anhydride, reactions  
 108-31-6, Maleic anhydride, reactions 110-15-6D, Succinic acid, esters  
 110-16-7D, Maleic acid, esters 1333-74-0, Hydrogen, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)
- IT 109-99-9P, Thf, preparation  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or gamma-butyrolactone or)
- IT 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (two-stage process for the hydrogenation of maleic acid into gamma-butyrolactone or THF or)
- IT 96-48-0P,  $\gamma$ -Butyrolactone  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or)
- RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



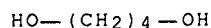
- IT 108-30-5, Succinic anhydride, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or THF or gamma-butyrolactone)
- RN 108-30-5 HCAPLUS  
 CN 2,5-Furandione, dihydro- (CA INDEX NAME)



- IT 109-99-9P, Thf, preparation  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (two-stage process for the hydrogenation of maleic acid into 1,4-butanediol or gamma-butyrolactone or)
- RN 109-99-9 HCAPLUS  
 CN Furan, tetrahydro- (CA INDEX NAME)



IT 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (two-stage process for the hydrogenation of maleic acid into  
 gamma-butyrolactone or THF or)  
 RN 110-63-4 HCAPLUS  
 CN 1,4-Butanediol (CA INDEX NAME)



L36 ANSWER 6 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2001:813999 HCAPLUS Full-text  
 DOCUMENT NUMBER: 135:346136  
 TITLE: Procedure for distillative separation of  
 mixtures containing tetrahydrofuran,  
 γ-butyrolactone, and/or 1,4-butandiol  
 INVENTOR(S): Kaibel, Gerd; Weck, Alexander; Rahn, Ralf-Thomas  
 PATENT ASSIGNEE(S): Basf A.-G., Germany  
 SOURCE: Ger. Offen., 22 pp.  
 CODEN: GWXXBX  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

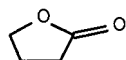
PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 10021703	A1	20011108	DE 2000-10021703	20000504
WO 2001085708	A1	20011115	WO 2001-EP4974	20010503
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG EP 1280787 A1 20030205 EP 2001-951476 20010503 R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR BR 2001010477 A 20030401 BR 2001-10477 20010503 JP 2003532720 T 20031105 JP 2001-582309 20010503 TW 527353 B 20030411 TW 2001-90110755 20010504 MX 2002PA10530 A 20030310 MX 2002-PA10530 20021025 US 2003106786 A1 20030612 US 2002-258938 20021029 US 6846389 B2 20050125				
PRIORITY APPLN. INFO.:			DE 2000-10021703	A 20000504
			WO 2001-EP4974	W 20010503

AB A procedure is disclosed for continuous distillative separation of mixts.  
 containing THF, γ-butyrolactone, and/or 1,4-butandiol to ≥3 fractions. The  
 mixts. result from hydrogenation of maleic anhydride, maleic acid, and its  
 esters. Separation is carried out in a system of distillation columns which



contains  $\geq 1$  column with a separation wall internal structure or  $\geq 1$  set of thermally coupled conventional distillation columns.

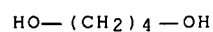
IC ICM B01D003-14  
 CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)  
 ST THF butyrolactone butandiol distn sepn  
 IT Distillation  
     (fractional; in separation of mixts. containing THF,  $\gamma$ -butyrolactone, and/or 1,4-butanediol)  
 IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P,  
 Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol,  
 preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)  
     (distillative separation of mixts. containing THF,  $\gamma$ -butyrolactone, and/or 1,4-butanediol)  
 IT 108-31-6, Maleic anhydride, processes 110-16-7, Maleic acid, processes 110-16-7D, Maleic acid, esters  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
     (distillative separation of mixts. containing THF,  $\gamma$ -butyrolactone, and/or 1,4-butanediol from hydrogenation of)  
 IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P,  
 Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol,  
 preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PREP (Preparation); PROC (Process)  
     (distillative separation of mixts. containing THF,  $\gamma$ -butyrolactone, and/or 1,4-butanediol)  
 RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
 CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS  
 CN 1,4-Butanediol (CA INDEX NAME)



L36 ANSWER 7 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 1999:708724 HCAPLUS Full-text  
 DOCUMENT NUMBER: 131:323036  
 TITLE: Production of 1,4-butanediol  
 INVENTOR(S): Fischer, Rolf; Kaibel, Gerd; Pinkos, Rolf; Rahn, Ralf-Thomas  
 PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany  
 SOURCE: PCT Int. Appl., 23 pp.  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9955659	A1	19991104	WO 1999-EP2587	19990416
W: CA, CN, JP, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19818248	A1	19991028	DE 1998-19818248	19980423
TW 223649	B	20041111	TW 1999-88106020	19990415
CA 2329477	A1	19991104	CA 1999-2329477	19990416
EP 1073620	A1	20010207	EP 1999-920693	19990416
EP 1073620	B1	20030709		
R: BE, CH, DE, FR, GB, IT, LI, NL				
JP 2002512996	T	20020508	JP 2000-545820	19990416
MX 2000PA09664	A	20010316	MX 2000-PA9664	20001002
US 6350924	B1	20020226	US 2000-673134	20001011
PRIORITY APPLN. INFO.:			DE 1998-19818248	A 19980423
			WO 1999-EP2587	W 19990416

AB Butanediol (and possibly  $\gamma$ -butyrolactone and THF) is obtained by oxidizing butane or benzene to produce a product containing maleic anhydride (MA), absorption of the MA from the product stream by means of an inert, high-boiling solvent in an absorption stage, which yields a liquid absorption product, and esterification of this liquid MA absorption product with a C1-5 alc. in an esterification step, yielding an esterification product containing the corresponding maleate diester and high-boiling inert solvent. This is followed by hydrogenation/hydrogenolysis of the esterification product, which results in a product containing 1,4-butanediol and optionally  $\gamma$ -butyrolactone and THF as well as C1-5 alc. This product is separated by distillation and the alc. is returned to the esterification zone. Prior to hydrogenation /hydrogenolysis the esterification product is separated by distillation under reduced pressure into the diester and the inert solvent, the inert solvent is returned to the absorption stage, and the diester is hydrogenated in the liquid phase on a fixed-bed catalyst. An example is given in which di-Me maleate is hydrogenated /hydrogenolyzed in the liquid phase at 250 bar to give 98% butanediol; in the gas phase at 62 bar the yield is 79%.

IC ICM C07C051-16  
 ICS C07C067-03; C07C069-60; C07C029-17; C07D307-08; C07D307-32

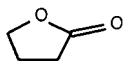
CC 35-2 (Chemistry of Synthetic High Polymers)

ST butanediol prodn maleate ester hydrogenation hydrogenolysis;  
 butyrolactone prodn maleate ester hydrogenation hydrogenolysis;  
 THF prodn maleate ester hydrogenation hydrogenolysis

IT Hydrogenation catalysts  
 Hydrogenolysis catalysts  
 (for hydrogenation/hydrogenolysis of di-Me maleate to butanediol)

IT Group IB elements  
 Group IIIA elements

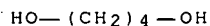
Group IVA elements  
 Group VA elements  
 Group VIB elements  
 Group VIIB elements  
 Group VIII elements  
 RL: CAT (Catalyst use); USES (Uses)  
 (in hydrogenation/hydrogenolysis catalysts for dialkyl  
 maleates)  
 IT 7440-50-8, Copper, uses 248954-28-1, T 4489  
 RL: CAT (Catalyst use); USES (Uses)  
 (catalyst for hydrogenation/hydrogenolysis of di-Me maleate  
 to butanediol)  
 IT 624-48-6, Dimethyl maleate  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (hydrogenation/hydrogenolysis of di-Me maleate to butanediol)  
 IT 108-31-6P, Maleic anhydride, preparation  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
 (Preparation); RACT (Reactant or reagent)  
 (intermediate in production of butanediol, butyrolactone and THF)  
 IT 110-16-7DP, Maleic acid, C1-5-dialkyl esters  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
 (Preparation); RACT (Reactant or reagent)  
 (intermediates in production of butanediol, butyrolactone and THF)  
 IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, THF,  
 preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (production by hydrogenation/hydrogenolysis of maleate diesters)  
 IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, THF,  
 preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (production by hydrogenation/hydrogenolysis of maleate diesters)  
 RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
 CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS  
 CN 1,4-Butanediol (CA INDEX NAME)



REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 8 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1999:529120 HCAPLUS Full-text

DOCUMENT NUMBER: 131:144965

TITLE: Absorptive method for separating and purifying maleic  
anhydride from maleic anhydride-containing  
hydrocarbon-oxidation stream mixtures by  
stripping

INVENTOR(S): Pinkos, Rolf; Rahn, Ralf-Thomas

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: PCT Int. Appl., 20 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9941223	A1	19990819	WO 1999-EP900	19990211
W: CA, CN, IN, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19806038	A1	19990819	DE 1998-19806038	19980213
CA 2318114	A1	19990819	CA 1999-2318114	19990211
EP 1056708	A1	20001206	EP 1999-907539	19990211
EP 1056708	B1	20011121		
R: BE, DE, ES, FR, GB, IT, NL				
ES 2168852	T3	20020616	ES 1999-907539	19990211
US 6329532	B1	20011211	US 2000-622172	20000814
PRIORITY APPLN. INFO.:			DE 1998-19806038	A 19980213
			WO 1999-EP900	W 19990211

AB Maleic anhydride is separated from maleic anhydride-containing reactor waste gases (resulting from maleic anhydride production by C4 hydrocarbon oxidation) by contacting the gas stream with a high-boiling inert absorption agent for maleic anhydride (e.g., di-Me phthalate) and the maleic anhydride is separated from the resulting liquid adsorbate phase by steam stripping. An alc. (e.g., methanol) is used as the desorption agent and maleic anhydride at least partly reacts with the alc. to yield a mono- and diester.

IC ICM C07C051-573

ICS C07C067-08; C07C057-145; C07C069-60; C07C029-17; C07D307-08;  
C07D307-33; C07C031-20

CC 35-2 (Chemistry of Synthetic High Polymers)

Section cross-reference(s): 27, 48

IT Hydrocarbons, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)

(C4; absorptive method for separating and purifying maleic anhydride from maleic anhydride-containing hydrocarbon-oxidation stream mixts. by stripping)

IT Absorption

Hydrogenation

Purification

(absorptive method for separating and purifying maleic anhydride from

maleic

anhydride-containing hydrocarbon-oxidation stream mixts. by stripping)

IT Esterification

(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping and)

IT Alcohols, uses  
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical  
process); PROC (Process); USES (Uses)  
(desorbent; absorptive method for separating and purifying maleic anhydride  
from maleic anhydride-containing hydrocarbon-oxidation stream mixts.  
by stripping)

IT Oxidation  
(gas-phase; absorptive method for separating and purifying maleic anhydride  
from maleic anhydride-containing hydrocarbon-oxidation stream mixts.  
by stripping)

IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

IT 624-48-6P, Dimethyl maleate 3052-50-4P, Monomethyl maleate  
RL: IMF (Industrial manufacture); PUR (Purification or  
recovery); PREP (Preparation)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

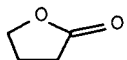
IT 110-16-7DP, Maleic acid, mono- and diesters  
RL: IMF (Industrial manufacture); PUR (Purification or  
recovery); RCT (Reactant); PREP (Preparation); RACT  
(Reactant or reagent)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

IT 64-17-5, Ethanol, uses 67-56-1, Methanol, uses 71-36-3, 1-Butanol,  
uses 131-11-3, Dimethyl phthalate  
RL: NUU (Other use, unclassified); PEP (Physical, engineering or chemical  
process); PROC (Process); USES (Uses)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

IT 108-31-6P, Maleic anhydride, preparation  
RL: PUR (Purification or recovery); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(absorptive method for separating and purifying maleic anhydride from  
maleic anhydride-containing hydrocarbon-oxidation stream mixts. by  
stripping)

RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS  
CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

REFERENCE COUNT: 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 9 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 1999:451264 HCAPLUS Full-text  
DOCUMENT NUMBER: 131:74099  
TITLE: Hydrogenation process for the production of tetrahydrofuran,  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters  
INVENTOR(S): Bertola, Aldo  
PATENT ASSIGNEE(S): Eurodiol S.A., Belg.  
SOURCE: PCT Int. Appl., 19 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: English  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9935113	A2	19990715	WO 1999-EP14	19990105
W:	AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM			
RW:	GH, GM, KE, LS, MW, SD, SZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG			
BE 1011698	A6	19991207	BE 1998-12	19980108
CA 2280881	A1	19990715	CA 1999-2280881	19990105

AU 9927157	A	19990726	AU 1999-27157	19990105
EP 966416	A2	19991229	EP 1999-907352	19990105
EP 966416	B1	20020612		

R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO

BR 9904793	A	20000516	BR 1999-4793	19990105
JP 2001516366	T	20010925	JP 1999-535661	19990105
AT 219039	T	20020615	AT 1999-907352	19990105
ES 2178875	T3	20030101	ES 1999-907352	19990105
US 6248906	B1	20010619	US 1999-367045	19990806

PRIORITY APPLN. INFO.: BE 1998-12 A 19980108  
WO 1999-EP14 W 19990105

- AB THF,  $\gamma$ -butyrolactone and butanediol are prepared starting from maleic anhydride esters (e.g., di-Me maleate) in a process consisting of two hydrogenations. In the primary hydrogenation, THF and  $\gamma$ -butyrolactone are formed, the THF fractionated out, and the  $\gamma$ -butyrolactone fed to a secondary hydrogenation where it is converted into butanediol. Process flow diagrams are presented.
- IC ICM C07C029-149  
ICS C07D307-08; C07D307-32
- CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 23, 27, 48
- ST butanediol manuf maleic anhydride ester hydrogenation; THF manuf maleic anhydride ester hydrogenation; butyrolactone manuf maleic anhydride ester hydrogenation
- IT Distillation  
(of hydrogenated maleic anhydride esters in the separation of THF from  $\gamma$ -butyrolactone)
- IT Hydrogenation  
(of maleic anhydride esters in the manufacture of THF and  $\gamma$ -butyrolactone and butanediol)
- IT 1314-13-2, Zinc oxide, uses 1344-28-1, Aluminum oxide (Al<sub>2</sub>O<sub>3</sub>), uses 7440-50-8, Copper, uses 7631-86-9, Silica, uses 11104-65-7, Copper chromite  
RL: CAT (Catalyst use); USES (Uses)  
(hydrogenation process for the production of THF and  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters)
- IT 109-99-9P, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation process for the production of THF and  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters)
- IT 96-48-0P 106-65-0P, Dimethyl succinate 110-15-6DP, Butanedioic acid, esters, preparation  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
(hydrogenation process for the production of THF and  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters)
- IT 110-16-7D, 2-Butenedioic acid (2Z)-, esters, reactions 624-48-6, Dimethyl maleate  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation process for the production of THF and  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters)
- IT 109-99-9P, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation process for the production of THF and  $\gamma$ -butyrolactone and butanediol from maleic anhydride esters)

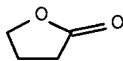
RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS  
CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

IT 96-48-0P  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)  
(hydrogenation process for the production of THF and  
γ-butyrolactone and butanediol from maleic anhydride esters)  
RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



L36 ANSWER 10 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 1999:350642 HCAPLUS Full-text  
DOCUMENT NUMBER: 130:352767  
TITLE: Process for preparing gamma-butyrolactone,  
butane-1,4-diol and tetrahydrofuran by the  
hydrogenation of esterified maleic anhydride  
INVENTOR(S): Tuck, Michael William Marshall; Wood, Michael Anthony;  
Hiles, Andrew George  
PATENT ASSIGNEE(S): Kvaerner Process Technology Limited, UK  
SOURCE: PCT Int. Appl., 34 pp.  
CODEN: PIXXD2  
DOCUMENT TYPE: Patent  
LANGUAGE: English  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
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WO 9925678	A1	19990527	WO 1998-GB3264	19981102
W:	AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW			



RW: GH, GM, KE, LS, MW, SD, SZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES,  
 FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG, CI,  
 CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

ZA 9809588	A	19990601	ZA 1998-9588	19981021
TW 444007	B	20010701	TW 1998-87117974	19981029
CA 2309997	A1	19990527	CA 1998-2309997	19981102
AU 9897538	A	19990607	AU 1998-97538	19981102
AU 751187	B2	20020808		
EP 1030830	A1	20000830	EP 1998-951579	19981102
EP 1030830	B1	20030305		
R: BE, DE, ES, FR, GB, IT, NL				
BR 9814185	A	20001003	BR 1998-14185	19981102
JP 2001523657	T	20011127	JP 2000-521063	19981102
CN 1125026	B	20031022	CN 1998-811037	19981102
ES 2194356	T3	20031116	ES 1998-951579	19981102
NO 2000002473	A	20000512	NO 2000-2473	20000512
MX 2000PA04663	A	20020311	MX 2000-PA4663	20000512
US 6239292	B1	20010529	US 2000-554194	20000628

PRIORITY APPLN. INFO.:

GB 1997-24004 A 19971113  
 WO 1998-GB3264 W 19981102

- AB A process for the production of at least one C4 compound selected from 1,4-butanediol,  $\gamma$ -butyrolactone, and THF is described in which a solution of maleic anhydride in a high-boiling ester is esterified with a C1-4 alc. to form the corresponding di-(C1-4 alkyl) maleate, which is hydrogenated to form the title compd(s). The high-boiling ester has a b.p. which is about 30° higher than that of the di-(C1-4 alkyl) maleate and is selected from di-(C1-4 alkyl)esters of alkyl dicarboxylic acids containing up to 13 carbon atoms (e.g., di-Me sebacate), mono- and di-(C10-18 alkyl)esters of maleic acid, fumaric acid, succinic acid, and their mixts., (C1-4 alkyl)esters of naphthalenemonocarboxylic acids, tri-(C1-4 alkyl)esters of tricarboxylic acids, and di-(C1-4 alkyl)esters of isophthalic acid.
- IC ICM C07C067-08  
 ICS C07C069-60; C07C029-17; C07C031-20; C07D307-08; C07D307-32
- CC 35-2 (Chemistry of Synthetic High Polymers)  
 Section cross-reference(s): 23, 27, 48
- ST butanediol manuf hydrogenation maleate ester; maleic anhydride esterification prepn maleate ester; butyrolactone manuf hydrogenation maleate ester; THF manuf hydrogenation maleate ester
- IT Esters, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (diesters, high-boiling solvents; in the manufacture of gamma-butyrolactone and/or butane-1,4-diol and/or THF by the hydrogenation of esterified maleic anhydride)
- IT Carboxylic acids, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (esters, high-boiling solvents; in the manufacture of gamma-butyrolactone and/or butane-1,4-diol and/or THF by the hydrogenation of esterified maleic anhydride)
- IT Hydrogenation  
 (of esterified maleic anhydride in the manufacture of gamma-butyrolactone and/or butane-1,4-diol and/or THF)
- IT Distillation  
 (of reaction mixts. in the manufacture of gamma-butyrolactone and/or butane-1,4-diol and/or THF)
- IT 93-09-4D, 2-Naphthalenecarboxylic acid, C1-4 alkyl esters 106-79-6, Dimethyl sebacate 110-15-6D, Succinic acid, C10-18 alkyl diesters 110-16-7D, Maleic acid, C10-18 alkyl diesters 110-17-8D, Fumaric acid, C10-18 alkyl diesters 121-91-5D, Isophthalic acid, C1-4 alkyl esters 1320-04-3D, Naphthalenecarboxylic acid, C1-4 alkyl esters 1459-93-4,

Dimethyl isophthalate 2459-10-1, Trimethyl 1,2,4-benzenetricarboxylate  
 28804-90-2, Methyl naphthalenecarboxylate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (high-boiling solvents; process for preparing gamma-butyrolactone and/or  
 butane-1,4-diol and/or THF by the hydrogenation of esterified  
 maleic anhydride)

IT 7440-50-8, Copper, uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (hydrogenation catalyst; process for preparing  
 gamma-butyrolactone and/or butane-1,4-diol and/or THF by the  
 hydrogenation of esterified maleic anhydride)

IT 1314-62-1, Vanadium pentoxide, uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (oxidation catalyst; process for preparing gamma-butyrolactone and/or  
 butane-1,4-diol and/or THF by the hydrogenation of esterified  
 maleic anhydride)

IT 106-97-8, Butane, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (partial oxidation in manufacture of maleic anhydride; process for  
 preparing  
 gamma-butyrolactone and/or butane-1,4-diol and/or THF by the  
 hydrogenation of esterified maleic anhydride)

IT 818-88-2P, Monomethyl sebacate  
 RL: BYP (Byproduct); PREP (Preparation)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

IT 71-36-3P, 1-Butanol, preparation  
 RL: BYP (Byproduct); PEP (Physical, engineering or chemical  
 process); PUR (Purification or recovery); PREP  
 (Preparation); PROC (Process)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

IT 115-10-6P, Dimethyl ether 7732-18-5P, Water, preparation  
 RL: BYP (Byproduct); REM (Removal or disposal); PREP  
 (Preparation); PROC (Process)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

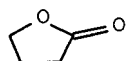
IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
 preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

IT 110-16-7DP, 2-Butenedioic acid (2Z)-, C1-4 alkyl diesters, preparation  
 624-48-6P, Dimethyl maleate  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
 (Preparation); RACT (Reactant or reagent)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

IT 108-31-6, 2,5-Furandione, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf,  
 preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (process for preparing gamma-butyrolactone and/or butane-1,4-diol and/or  
 THF by the hydrogenation of esterified maleic anhydride)

RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS  
CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

REFERENCE COUNT: 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 11 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1999:350639 HCAPLUS Full-text

DOCUMENT NUMBER: 130:352766

TITLE: Process and catalysts for the manufacture of  
1,4-butanediol,  $\gamma$ -butyrolactone and  
tetrahydrofuran by the hydrogenation of  
maleic anhydride

INVENTOR(S): Tuck, Michael William Marshall; Wood, Michael Anthony;  
Hiles, Andrew George

PATENT ASSIGNEE(S): Kvaerner Process Technology Limited, UK

SOURCE: PCT Int. Appl., 20 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 1

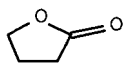
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9925675	A1	19990527	WO 1998-GB3257	19981102
W:	AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW			
RW:	GH, GM, KE, LS, MW, SD, SZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG			
ZA 9809584	A	19990825	ZA 1998-9584	19981021
TW 460444	B	20011021	TW 1998-87117973	19981029

CA 2309992	A1	19990527	CA 1998-2309992	19981102
AU 9897533	A	19990607	AU 1998-97533	19981102
AU 761294	B2	20030529		
BR 9814141	A	20001003	BR 1998-14141	19981102
EP 1049657	A1	20001108	EP 1998-951574	19981102
EP 1049657	B1	20030319		
R: BE, DE, ES, FR, GB, IT, NL				
JP 2001523656	T	20011127	JP 2000-521062	19981102
ES 2195406	T3	20031201	ES 1998-951574	19981102
CN 1132805	B	20031231	CN 1998-811036	19981102
NO 2000002472	A	20000512	NO 2000-2472	20000512
MX 2000PA04661	A	20030820	MX 2000-PA4661	20000512
US 6204395	B1	20010320	US 2000-554239	20000629
PRIORITY APPLN. INFO.:			GB 1997-24195	A 19971114
			WO 1998-GB3257	W 19981102

- AB In the title process, a vapor stream containing maleic anhydride, water, and carbon oxides is contacted in an absorption zone with a high-boiling ester (e.g., di-Me sebacate) solvent to form a solution of maleic anhydride in the high-boiling ester, which has a b.p. under atmospheric pressure of  $\geq 30^\circ$  higher than that of maleic anhydride and is selected from di-(C1-4 alkyl) esters of alkyl dicarboxylic acids containing up to 13 carbon atoms, mono- and di-(C10-18 alkyl) esters of maleic acid, fumaric acid, succinic acid, and mixts. thereof, C1-4 alkyl esters of naphthalene-monocarboxylic acids, tri-(C1-4 alkyl) esters of aromatic tricarboxylic acids, and di-(C1-4 alkyl) isophthalates. The maleic anhydride in the solution is stripped with a gaseous stream containing hydrogen forming a vapor stream comprising hydrogen and maleic anhydride, which is contacted in a hydrogenation zone with a heterogeneous hydrogenation catalyst to convert the maleic anhydride into  $\geq 1$  of the title C4 compds.
- IC ICM C07C029-149  
ICS C07D307-08; C07D307-33
- CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 23, 27, 45, 48, 67
- ST butyrolactone manuf maleic anhydride hydrogenation; butanediol manuf maleic anhydride hydrogenation; THF manuf maleic anhydride hydrogenation; ester solvent
- IT Esters, uses  
RL: NUU (Other use, unclassified); USES (Uses)  
(diesters; high-boiling solvents for the hydrogenation of maleic anhydride into 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT Carboxylic acids, uses  
RL: NUU (Other use, unclassified); USES (Uses)  
(esters; high-boiling solvents for the hydrogenation of maleic anhydride into 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT Hydrogenation  
(gas-phase; of maleic anhydride in an inert high-boiling ester for the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT Distillation  
(in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT Steam  
(process and catalysts for the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF by the hydrogenation of maleic anhydride streams containing)
- IT 71-36-3P, 1-Butanol, preparation  
RL: BYP (Byproduct); REM (Removal or disposal); PREP (Preparation); PROC (Process)

- (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf, preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 108-31-6P, Maleic anhydride, preparation  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 630-08-0, Carbon monoxide, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 106-97-8, n-Butane, reactions 1333-74-0, Hydrogen, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 1314-62-1, Vanadium pentoxide, uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (oxidation catalyst for the manufacture of maleic anhydride; hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 106-79-6, Dimethyl sebacate 110-15-6D, Succinic acid, mono- and di-(C10-18 alkyl) esters 110-16-7D, Maleic acid, mono- and di-(C10-18 alkyl) esters 110-17-8D, Fumaric acid, mono- and di-(C10-18 alkyl) esters 121-91-5D, Isophthalic acid, di-(C1-4 alkyl) alkyl esters 1320-04-3D, Naphthalenecarboxylic acid, C1-4 alkyl esters 1459-93-4, Dimethyl isophthalate 28804-90-2, Methyl naphthalenecarboxylate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (solvents; hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Thf, preparation 110-63-4P, 1,4-Butanediol, preparation  
 RL: IMF (Industrial manufacture); PREP (Preparation)  
 (hydrogenation of maleic anhydride in a high-boiling ester solvent in the manufacture of 1,4-butanediol and/or  $\gamma$ -butyrolactone and/or THF)
- RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS

CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS

CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 12 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1998:410651 HCAPLUS Full-text

DOCUMENT NUMBER: 129:96847

TITLE: Improved hydrogenation catalysts,  
their preparation and use for manufacture of  
1,4-butanediol

INVENTOR(S): Raymond, John; Attig, Thomas George; Dubbert, Robert  
Allen

PATENT ASSIGNEE(S): Standard Oil Co., USA

SOURCE: Eur. Pat. Appl., 9 pp.

CODEN: EPXXDW

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 2

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 848991	A1	19980624	EP 1997-310014	19971211
EP 848991	B1	20040324		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO				
SG 74602	A1	20000822	SG 1997-3830	19971022
AU 9743631	A	19980625	AU 1997-43631	19971029
AU 720496	B2	20000601		
IN 1997DE03178	A	20051104	IN 1997-DE3178	19971105
AT 262376	T	20040415	AT 1997-310014	19971211
ES 2218646	T3	20041116	ES 1997-310014	19971211
JP 10192709	A	19980728	JP 1997-347597	19971217
JP 3941981	B2	20070711		
CN 1185993	A	19980701	CN 1997-108787	19971219
CN 1094791	B	20021127		
TW 415938	B	20001221	TW 1997-86119385	19971219
EP 1077080	A1	20010221	EP 1999-306525	19990818
EP 1077080	B1	20061122		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, CY				
AT 345867	T	20061215	AT 1999-306525	19990818
SG 84543	A1	20011120	SG 1999-4399	19990908

IN 2005DE02276	A	20070810	IN 2005-DE2276	20050825
JP 2007181829	A	20070719	JP 2007-26179	20070205
PRIORITY APPLN. INFO.:			US 1996-781945	A 19961220
			JP 1997-347597	A3 19971217
			EP 1999-306525	A 19990818

AB An improved catalyst for hydrogenation of maleic acid, maleic anhydride, or other hydrogenatable precursor to 1,4-butanediol and/or THF comprises Pd, Ag, Re, and Fe on a carbon support. Thus, ACL carbon extrudate was impregnated with Fe(NO<sub>3</sub>)<sub>3</sub>, then with a mixture of Pd nitrate and perrenic acid, and finally with AgNO<sub>3</sub> to give a catalyst containing Pd 3.3, Ag 3.3, Re 7.1, and Fe 0.3 weight%. This catalyst was mixed with quartz chips, reduced in a H stream at 0 → 230°, and contacted with an aqueous liquid feed containing 35.5% maleic acid in a H atmospheric at 2500 psig in 2 stages at 100° and 153°, resp., to show 89.5% selectivity to 1,4-butanediol, vs. 86.3% at 162° final stage temperature for a similar catalyst from which the Fe was omitted.

IC ICM B01J023-656  
ICS B01J023-68; C07C029-149; C07C031-20; C07D307-08; B01J023-89

CC 45-4 (Industrial Organic Chemicals, Leather, Fats, and Waxes)  
Section cross-reference(s): 67

ST iron palladium rhenium silver hydrogenation catalyst;  
maleic acid hydrogenation catalyst; carbon support  
hydrogenation catalyst; butanediol manuf  
hydrogenation catalyst

IT Hydrogenation catalysts  
(Re-Ag-Pd-Fe/C; hydrogenation catalysts for manufacture  
of butanediol)

IT 7439-89-6, Iron, uses 7440-05-3, Palladium, uses 7440-15-5, Rhenium,  
uses 7440-22-4, Silver, uses  
RL: CAT (Catalyst use); USES (Uses)  
(hydrogenation catalysts for manufacture of butanediol)

IT 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation catalysts for manufacture of butanediol)

IT 96-48-0, γ-Butyrolactone 106-65-0, Dimethyl succinate  
108-30-5, Succinic anhydride, reactions  
108-31-6, Maleic anhydride, reactions 110-15-6, Succinic acid, reactions  
110-16-7, Maleic acid, reactions 110-17-8, Fumaric acid, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation catalysts for manufacture of butanediol)

IT 109-99-9P, THF, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation catalysts for manufacture of butanediol  
and)

IT 7601-90-3, Perchloric acid, reactions 7681-52-9, Sodium hypochlorite  
7697-37-2, Nitric acid, reactions 7722-84-1, Hydrogen peroxide,  
reactions 7727-54-0, Ammonium persulfate 7782-44-7, Oxygen, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(oxidant; in preparation of carbon-supported hydrogenation  
catalysts for manufacture of butanediol)

IT 7440-44-0, Carbon, uses  
RL: CAT (Catalyst use); USES (Uses)  
(support; hydrogenation catalysts for manufacture of  
butanediol)

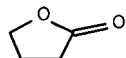
IT 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation catalysts for manufacture of butanediol)

RN 110-63-4 HCAPLUS

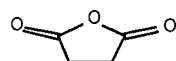
CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

IT 96-48-0,  $\gamma$ -Butyrolactone 108-30-5,  
Succinic anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation catalysts for manufacture of butanediol)  
RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 108-30-5 HCAPLUS  
CN 2,5-Furandione, dihydro- (CA INDEX NAME)



IT 109-99-9P, THF, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(hydrogenation catalysts for manufacture of butanediol  
and)  
RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 13 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 1998:247290 HCAPLUS Full-text  
DOCUMENT NUMBER: 128:243940  
TITLE: Process for preparation of gamma-butyrolactone by  
hydrogenation  
INVENTOR(S): Tong, Lishan; Wang, Haijing; Feng, Weisun  
PATENT ASSIGNEE(S): China Petrochemical Corp., Peop. Rep. China  
SOURCE: Faming Zhuanli Shenqing Gongkai Shuomingshu, 12 pp.  
CODEN: CNXXEV  
DOCUMENT TYPE: Patent  
LANGUAGE: Chinese  
FAMILY ACC. NUM. COUNT: 1  
PATENT INFORMATION:



PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
CN 1139106	A	19970101	CN 1995-106765	19950626
CN 1046509	B	19991117		
PRIORITY APPLN. INFO.:			CN 1995-106765	19950626
OTHER SOURCE(S):		CASREACT 128:243940		

AB Characterized is a process for preparation of the title compound by hydrogenation of maleic or succinic anhydride in alc. over metal catalysts  $\text{Cu}_a\text{Zn}_b\text{Cr}_c\text{Zr}_x\text{O}_x$  ( $a = 0.1-10$ ;  $b = c = 0.1-5$ ;  $x = \text{number of O}$ ) in a fixed-bed reactor. Thus, maleic anhydride in n-BuOH was hydrogenated at  $270^\circ$  for 1055 h in the presence of catalyst containing Cu, Zn, Cr and Zr to give  $\gamma$ -butyrolactone with 98% conversion and 92% selectivity.

IC ICM C07D307-33

CC 27-6 (Heterocyclic Compounds (One Hetero Atom))

ST butyrolactone prepn maleic anhydride hydrogenation; succinic anhydride hydrogenation butyrolactone prepn; metal oxide hydrogenation catalyst butyrolactone prepn; fixed bed reactor hydrogenation butyrolactone prepn

IT Hydrogenation  
Hydrogenation catalysts  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 109-21-7P, Butyl butyrate 109-99-9P, Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: BYP (Byproduct); PREP (Preparation)  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 1333-82-0, Chromic anhydride 7779-88-6, Zinc nitrate 10402-29-6, Copper nitrate 13746-89-9, Zirconium nitrate  
RL: CAT (Catalyst use); USES (Uses)  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 96-48-0P,  $\gamma$ -Butyrolactone  
RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 71-36-3, n-Butanol, uses  
RL: NUU (Other use, unclassified); USES (Uses)  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 108-30-5, Succinic anhydride, reactions  
108-31-6, Maleic anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(process for preparation of gamma-butyrolactone by hydrogenation)

IT 109-99-9P, Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: BYP (Byproduct); PREP (Preparation)  
(process for preparation of gamma-butyrolactone by hydrogenation)

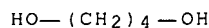
RN 109-99-9 HCAPLUS

CN Furan, tetrahydro- (CA INDEX NAME)

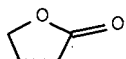


RN 110-63-4 HCAPLUS

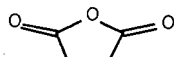
CN 1,4-Butanediol (CA INDEX NAME)



IT 96-48-0P,  $\gamma$ -Butyrolactone  
 RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
 (process for preparation of gamma-butyrolactone by hydrogenation)  
 RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



IT 108-30-5, Succinic anhydride, reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (process for preparation of gamma-butyrolactone by hydrogenation)  
 RN 108-30-5 HCAPLUS  
 CN 2,5-Furandione, dihydro- (CA INDEX NAME)



L36 ANSWER 14 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 1998:113036 HCAPLUS Full-text  
 DOCUMENT NUMBER: 128:192944  
 TITLE: Liquid Phase Hydrogenation of Maleic  
 Anhydride to 1,4-Butanediol in a Packed Bubble Column  
 Reactor  
 AUTHOR(S): Herrmann, Uwe; Emig, Gerhard  
 CORPORATE SOURCE: Universitaet Erlangen-Nuernberg, Erlangen, D-91058,  
 Germany  
 SOURCE: Industrial & Engineering Chemistry Research (1998),  
 37(3), 759-769  
 CODEN: IECRED; ISSN: 0888-5885  
 PUBLISHER: American Chemical Society  
 DOCUMENT TYPE: Journal  
 LANGUAGE: English

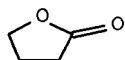
AB The liquid phase hydrogenation of maleic anhydride was investigated in a packed bubble column reactor using different copper-based catalysts. A copper-zinc catalyst was found to be active in the formation of 1,4-butanediol, whereas on zinc-free copper catalysts, mainly succinic anhydride and  $\gamma$ -butyrolactone were formed. At suitable reaction conditions, maleic anhydride hydrogenation over a copper-zinc catalyst gave valuable products with high yield and selectivity whereas succinic anhydride was absent in the reactor outlet. Based on a three-phase reactor model and a kinetic model of the reaction mechanism, the influence of reaction conditions on reactor performance was determined. The use of large particles and a high axial

- dispersion of liquid phase is a necessary condition for the feasibility of a "one-step-hydrogenation" of highly concentrated maleic anhydride feed solns. because of a significant decrease of succinic anhydride formation rate.
- CC 35-2 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 45, 67
- ST maleic anhydride hydrogenation butanediol prepn; copper zinc catalyst maleic anhydride hydrogenation; modeling maleic anhydride hydrogenation copper catalyst
- IT Dispersion (of materials)  
(axial; liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT Simulation and Modeling, physicochemical  
(for liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT Hydrogenation  
Hydrogenation catalysts  
Hydrogenation kinetics  
(liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 71-36-3P, n-Butanol, preparation 109-99-9P, preparation  
RL: BYP (Byproduct); PREP (Preparation)  
(byproduct; liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 39320-46-2, Girdler G 13  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst; liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 96-48-0P,  $\gamma$ -Butyrolactone 108-30-5P, preparation  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
(intermediate; liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 1314-13-2, Zinc oxide, uses 1317-38-0, Copper oxide, uses 7440-50-8, Copper, uses 61419-59-8, R 3-11 166243-16-9, R 3-12  
RL: CAT (Catalyst use); USES (Uses)  
(liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 108-31-6, 2,5-Furandione, reactions 1333-74-0, Hydrogen, reactions  
RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
(liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)
- IT 1344-28-1, Alumina, uses 10034-94-3  
RL: CAT (Catalyst use); USES (Uses)  
(support; liquid phase hydrogenation of maleic anhydride to 1,4-butanediol with different copper-based catalysts in packed bubble column reactor)

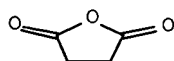
IT 109-99-9P, preparation  
RL: BYP (Byproduct); PREP (Preparation)  
(byproduct; liquid phase hydrogenation of maleic anhydride to  
1,4-butanediol with different copper-based catalysts in  
packed bubble column reactor)  
RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



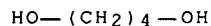
IT 96-48-0P,  $\gamma$ -Butyrolactone 108-30-5P, preparation  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP  
(Preparation); RACT (Reactant or reagent)  
(intermediate; liquid phase hydrogenation of maleic anhydride  
to 1,4-butanediol with different copper-based catalysts in  
packed bubble column reactor)  
RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 108-30-5 HCAPLUS  
CN 2,5-Furandione, dihydro- (CA INDEX NAME)



IT 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); PREP (Preparation)  
(liquid phase hydrogenation of maleic anhydride to  
1,4-butanediol with different copper-based catalysts in  
packed bubble column reactor)  
RN 110-63-4 HCAPLUS  
CN 1,4-Butanediol (CA INDEX NAME)



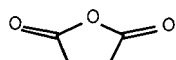
REFERENCE COUNT: 26 THERE ARE 26 CITED REFERENCES AVAILABLE FOR THIS  
RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 15 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

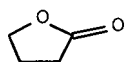
ACCESSION NUMBER: 1997:473313 HCAPLUS Full-text  
 DOCUMENT NUMBER: 127:66242  
 TITLE: Liquid Phase Hydrogenation of Maleic Anhydride and Intermediates on Copper-Based and Noble Metal Catalysts  
 AUTHOR(S): Herrmann, Uwe; Emig, Gerhard  
 CORPORATE SOURCE: Lehrstuhl fuer Technische Chemie I, Universitaet Erlangen-Nuernberg, Erlangen, D-91058, Germany  
 SOURCE: Industrial & Engineering Chemistry Research (1997), 36(8), 2885-2896  
 CODEN: IECRED; ISSN: 0888-5885  
 PUBLISHER: American Chemical Society  
 DOCUMENT TYPE: Journal  
 LANGUAGE: English

- AB The liquid phase hydrogenation of maleic anhydride and intermediates was investigated using copper-based and noble metal catalysts. The expts. were performed in a stirred tank slurry reactor in discontinuous as well as continuous operation. Copper chromites and noble metal catalysts were found to be suitable for the hydrogenation of maleic anhydride. However, the hydrogenation of succinic anhydride proceeded with high selectivity to  $\gamma$ -butyrolactone and 1,4-butanediol on copper zinc catalysts, whereas other copper catalysts revealed no activity in the formation of 1,4-butanediol. Selective sorption interactions of succinic anhydride with the zinc surface were assumed to be responsible for this effect. Starting from  $\gamma$ -butyrolactone all copper catalysts were active in the formation of 1,4-butanediol while noble metal catalysts showed no or little activity. Kinetic models have been proposed for the hydrogenation of maleic anhydride and intermediates on the basis of exptl. data obtained in a continuously operated stirred tank slurry reactor.
- CC 35-2 (Chemistry of Synthetic High Polymers)  
 Section cross-reference(s): 45, 67
- ST continuous stirred tank hydrogenation maleic anhydride; noble metal catalyst maleic anhydride hydrogenation; butyrolactone intermediate maleic anhydride hydrogenation; succinic anhydride intermediate maleic anhydride hydrogenation; rhenium palladium copper maleic anhydride hydrogenation; zinc catalyst maleic anhydride hydrogenation; ruthenium catalyst maleic anhydride hydrogenation; butanediol monomer prodn maleic anhydride hydrogenation; kinetics maleic anhydride hydrogenation metal catalyst
- IT Noble metals  
 RL: CAT (Catalyst use); USES (Uses)  
 (liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT Hydrogenation catalysts  
 Hydrogenation kinetics  
 (liquid-phase; liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 71-36-3P, 1-Butanol, preparation 79-09-4P, Propionic acid, preparation  
 RL: BYP (Byproduct); PREP (Preparation)  
 (liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 7440-05-3, Palladium, uses 7440-15-5, Rhenium, uses 7440-18-8, Ruthenium, uses 7440-47-3D, Chromium, compds., uses 7440-50-8, Copper, uses 7440-66-6, Zinc, uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 108-30-5P, Succinic anhydride, preparation

- RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 96-48-0P,  $\gamma$ -Butyrolactone  
RL: IMF (Industrial manufacture); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 109-99-9P, THF, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 108-31-6, Maleic Anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 1344-28-1, Alumina, uses 7440-44-0, Carbon, uses  
RL: CAT (Catalyst use); USES (Uses)  
(support; liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- IT 108-30-5P, Succinic anhydride, preparation  
RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- RN 108-30-5 HCAPLUS
- CN 2,5-Furandione, dihydro- (CA INDEX NAME)



- IT 96-48-0P,  $\gamma$ -Butyrolactone  
RL: IMF (Industrial manufacture); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)
- RN 96-48-0 HCAPLUS
- CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- IT 109-99-9P, THF, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: IMF (Industrial manufacture); SPN (Synthetic preparation); PREP (Preparation)

(liquid-phase hydrogenation of maleic anhydride and intermediates on copper-based and noble metal catalysts)

RN 109-99-9 HCAPLUS

CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS

CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

REFERENCE COUNT: 32 THERE ARE 32 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L36 ANSWER 16 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1993:538721 HCAPLUS Full-text

DOCUMENT NUMBER: 119:138721

TITLE: Two-stage maleic anhydride hydrogenation process for 1,4-butanediol synthesis

INVENTOR(S): Budge, John R.; Attig, Thomas G.; Graham, Anne M.

PATENT ASSIGNEE(S): Standard Oil Co., USA

SOURCE: U.S., 5 pp.

CODEN: USXXAM

DOCUMENT TYPE: Patent

LANGUAGE: English

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
US 5196602	A	19930323	US 1991-814644	19911230
PRIORITY APPLN. INFO.:			US 1991-814644	19911230
OTHER SOURCE(S):		CASREACT 119:138721		

AB In the 1st stage maleic anhydride (I) and/or maleic acid (LHSV 0.01-10/h) is contacted with H (GHSV 100-100,000/h) at .apprx.100-350°/14.7- 2500 psi over (promoted) Cu chromite catalyst to give succinic anhydride (II) and/or  $\gamma$ -butyrolactone (III), which in the 2nd stage are contacted with H for 0.1-10 min at .apprx.180-350°/500-2000 psi over Ru0.001-2M0.01-2M'0.01-2M''0.01- 10x (M = at least 1 of Ni or Pd; M' = at least 1 of Fe, Co, Rh, Os, Ir, or Pt; x is sufficient to satisfy the valency requirements) to give 1,4-butanediol (IV) and small amts. of controllable byproducts. Thus,  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> (10-30 mesh; 4m<sup>2</sup>/g surface area) was impregnated, in 2 stages, with aqueous Ru(NO<sub>3</sub>)<sub>3</sub>, Co(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O, Ni(NO<sub>3</sub>)<sub>3</sub>.6H<sub>2</sub>O and dried 4h and then overnight at 120° and calcined 3h at 350° then impregnated with Zn(OAc)<sub>2</sub>.2H<sub>2</sub>O dried overnight at 120° and calcined 3h at 350° to give catalysts RuCoNiZn/Al<sub>2</sub>O<sub>3</sub> (B) or RuCoNiZn0.4/Al<sub>2</sub>O<sub>3</sub> (A). Catalyst A or B was prereduced in H in a fixed bed reactor and was then used in the comparative hydrogenation of I-III (case i) vs. II-III (case ii) 0.33h (0.4 min contact time) at 215°/1300 psig under 8250/h GHSV H and 0.33/h LHSV (case, catalyst, % conversion selectivity for

IV, THF, PrOH, and BuOH given): i, A, 82.1, 10.8, 2.0, 0.8; ii, B, 92.9, 4.2, 2.1, 0.8.

IC ICM C07C029-149  
ICS C07C031-20

INCL 568864000

CC 23-7 (Aliphatic Compounds)  
Section cross-reference(s): 27, 35, 67

ST maleic anhydride hydrogenation ruthenium catalyst;  
mixed oxide ruthenium hydrogenation catalyst;  
butanediol

IT Hydrogenation catalysts  
(alumina supported ruthenium based mixed oxides, for maleic anhydride and related compds. to butanediol)

IT Phosphates, uses  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst containing, and ruthenium based mixed oxides, for hydrogenation of maleic anhydride and related compds. to butanediol)

IT 409-21-2, Silicon carbide, uses 1314-23-4, Zirconia, uses 7440-42-8D, Boron, compds. 7631-86-9, Silica, uses 13463-67-7, Titania, uses  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst containing, and ruthenium based mixed oxides, for hydrogenation of maleic anhydride and related compds. to butanediol)

IT 1306-19-0, Cadmium oxide, uses 1314-08-5, Palladium oxide 1332-37-2, Iron oxide, uses 7439-88-5, Iridium, uses 7439-89-6, Iron, uses 7440-04-2, Osmium, uses 7440-06-4, Platinum, uses 7440-16-6, Rhodium, uses 7440-43-9, Cadmium, uses 11129-89-8, Platinum oxide 12645-46-4, Iridium oxide 12680-36-3, Rhodium oxide 61970-39-6, Osmium oxide  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst from ruthenium based mixed oxides containing, for hydrogenation of maleic anhydride and related compds. to butanediol)

IT 149661-60-9, Cobalt nickel ruthenium zinc oxide  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(catalyst with low surface area alumina for hydrogenation of maleic anhydride and related compds. to butanediol)

IT 11104-65-7, Copper chromite  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst, for hydrogenation of maleic anhydride and related compds. to butanediol, promoters for)

IT 96-48-0,  $\gamma$ -Butyrolactone 108-30-5, Succinic anhydride, reactions 108-31-6, 2,5-Furandione, reactions 110-16-7, 2-Butenedioic acid (Z)-, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation of, to butanediol, catalysts for)

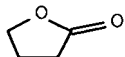
IT 71-23-8P, Propanol; reactions 71-36-3P, Butanol, reactions 109-99-9P, reactions 110-63-4P, 1,4-Butanediol, reactions  
RL: SPN (Synthetic preparation); PREP (Preparation)  
(preparation of)

IT 7440-44-0, Carbon, uses  
RL: USES (Uses)  
(promoter containing, for copper chromite catalyzed hydrogenation of maleic anhydride and related compds. to butanediol)

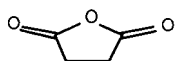
IT 7440-05-3, Palladium, uses 7440-50-8, Copper, uses  
RL: USES (Uses)  
(promoter, for copper chromite catalyzed



- hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 1344-70-3, Copper oxide  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(promoter, for copper chromite catalyzed hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 1344-28-1, Alumina, uses  
RL: USES (Uses)  
(promoter, for copper chromite hydrogenation catalysts or support for ruthenium based mixed oxide hydrogenation catalysts for maleic anhydride and related compds. to butanediol)
- IT 7440-18-8, Ruthenium, uses  
RL: USES (Uses)  
(supported catalyst from mixed oxides and, for hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 11113-84-1, Ruthenium oxide  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(supported catalyst from mixed oxides and, for hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 1314-13-2, Zinc oxide, uses 7440-02-0, Nickel, uses 7440-48-4, Cobalt, uses 7440-66-6, Zinc, uses  
RL: USES (Uses)  
(supported ruthenium based catalyst from mixed oxides and, for hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 11099-02-8, Nickel oxide 11104-61-3, Cobalt oxide  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(supported ruthenium based catalyst from mixed oxides and, for hydrogenation of maleic anhydride and related compds. to butanediol)
- IT 96-48-0,  $\gamma$ -Butyrolactone 108-30-5, Succinic anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation of, to butanediol, catalysts for)
- RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- RN 108-30-5 HCAPLUS  
CN 2,5-Furandione, dihydro- (CA INDEX NAME)



- IT 109-99-9P, reactions 110-63-4P, 1,4-Butanediol,

reactions

RL: SPN (Synthetic preparation); PREP (Preparation)  
(preparation of)

RN 109-99-9 HCAPLUS

CN Furan, tetrahydro- (CA INDEX NAME)



RN 110-63-4 HCAPLUS

CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

L36 ANSWER 17 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1991:558947 HCAPLUS Full-text

DOCUMENT NUMBER: 115:158947

TITLE: Preparation of tetrahydrofuran and  
γ-butyrolactoneINVENTOR(S): Zimmermann, Horst; Brenner, Karl; Scheiper, Hans  
Juergen; Sauer, Wolfgang; Hartmann, Horst

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: Ger. Offen., 5 pp.

CODEN: GWXXBX

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

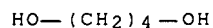
PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 4005293	A1	19910822	DE 1990-4005293	19900220
EP 443392	A1	19910828	EP 1991-101833	19910209
EP 443392	B1	19950809		
R: AT, BE, CH, DE, ES, FR, GB, IT, LI, NL, SE				
ES 2075229	T3	19951001	ES 1991-101833	19910209
JP 07053538	A	19950228	JP 1991-23440	19910218
JP 2930141	B2	19990803		
CA 2036626	A1	19910821	CA 1991-2036626	19910219
CA 2036626	C	20001107		
US 5319111	A	19940607	US 1992-931117	19920817
PRIORITY APPLN. INFO.:			DE 1990-4005293	A 19900220
			US 1991-658086	B1 19910220

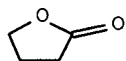
AB THF or THF and γ-butyrolactone were obtained in improved yields from the products of maleic acid, succinic acid, maleic anhydride, succinic anhydride or fumaric acid hydrogenation by treating the mixture with a protic acid. Thus, a maleic anhydride hydrogenation mixture containing THF 36.45, γ-butyrolactone 13.63, and 1,4-butanediol 17.91% was treated with 0.1% concentrated H<sub>2</sub>SO<sub>4</sub> at 130° to give a mixture containing THF 52.5, γ-

butyrolactone 14.46, and 1,4-butanediol 0% from which pure THF and  $\gamma$ -butyrolactone were obtained by distillation

IC ICM C07D307-08  
ICS C07D307-60; C07D307-33  
CC 27-6 (Heterocyclic Compounds (One Hetero Atom))  
IT 110-63-4P, 1,4-Butanediol, reactions  
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent) (preparation and dehydration of)  
IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Tetrahydrofuran, preparation  
RL: SPN (Synthetic preparation); PREP (Preparation) (preparation of, from maleic anhydride hydrogenation product)  
IT 110-63-4P, 1,4-Butanediol, reactions  
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent) (preparation and dehydration of)  
RN 110-63-4 HCAPLUS  
CN 1,4-Butanediol (CA INDEX NAME)



IT 96-48-0P,  $\gamma$ -Butyrolactone 109-99-9P, Tetrahydrofuran, preparation  
RL: SPN (Synthetic preparation); PREP (Preparation) (preparation of, from maleic anhydride hydrogenation product)  
RN 96-48-0 HCAPLUS  
CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



RN 109-99-9 HCAPLUS  
CN Furan, tetrahydro- (CA INDEX NAME)



L36 ANSWER 18 OF 19 HCAPLUS COPYRIGHT 2007 ACS on STN  
ACCESSION NUMBER: 1991:514336 HCAPLUS Full-text  
DOCUMENT NUMBER: 115:114336  
TITLE: Process for the preparation tetrahydrofuran or 1,4-butanediol by catalytic hydrogenation of  $\gamma$ -butyrolactone  
INVENTOR(S): Suzuki, Sadakatsu; Ichiki, Tatsumi; Ueno, Hiroshi  
PATENT ASSIGNEE(S): Tonen Co., Ltd., Japan

SOURCE: Eur. Pat. Appl., 8 pp.  
 CODEN: EPXXDW  
 DOCUMENT TYPE: Patent  
 LANGUAGE: English  
 FAMILY ACC. NUM. COUNT: 2  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
EP 431923	A2	19910612	EP 1990-313218	19901205
EP 431923	A3	19910918		
EP 431923	B1	19950607		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE				
JP 03178943	A	19910802	JP 1989-316474	19891207
CA 2030999	A1	19910608	CA 1990-2030999	19901128
CA 2030999	C	20020101		
ES 2072991	T3	19950801	ES 1990-313218	19901205
US 5326889	A	19940705	US 1992-971495	19921104
PRIORITY APPLN. INFO.:			JP 1989-316474	A 19891207
			US 1990-616488	A3 19901121
			US 1991-807974	B3 19911216

OTHER SOURCE(S): CASREACT 115:114336

AB A process for the preparation of 1,4-butanediol and THF comprises the catalytic hydrogenation of  $\gamma$ -butyrolactone in the gas phase over a solid catalyst containing Cu and Si or Cu and Cr and Mn or Cu, Cr, Mn, and Ba. A Cu oxide, Cr oxide, Mn oxide catalyst (G-89) was heated to 170° under a stream of N (40 kg/cm<sup>2</sup>) containing 2 vol % hydrogen; an autoclave was charged with the above reduced catalyst (30 g), maleic anhydride (100 g), 1,4-dioxane as solvent (120 g), and hydrogen (90 kg/cm<sup>2</sup>) to give a mixture containing 85 mol %  $\gamma$ -butyrolactone, 6.2 mol % THF, 2.3 mol % BuOH, and 1.4 mol % succinic anhydride. For comparison, the hydrogenation of a mixture of maleic anhydride and  $\gamma$ -butyrolactone using the above catalyst at 180°, 40 kg/cm<sup>2</sup> and a gas hourly space velocity of 9000 h<sup>-1</sup> gave a mixture containing 15.1 mol % 1,4-butanediol, 2.8 mol % THF, 81.9 mol %  $\gamma$ -butyrolactone and 0.3 mol % BuOH. A fixed bed reactor was charged with a catalyst prepared by reduction of a Cu oxide-silicon oxide catalyst (T-366) at 210° and the above  $\gamma$ -butyrolactone-containing mixture and hydrogen (100 times molar excess; 15 kg/cm<sup>2</sup>) was passed over the catalyst at a gas hourly space velocity of 4800 h<sup>-1</sup> to give a mixture containing 95.2 mol % THF and 4.6 mol % BuOH (100% conversion of  $\gamma$ -butyrolactone).

IC ICM C07C031-20

ICS C07C029-149; C07D307-08

CC 27-6 (Heterocyclic Compounds (One Hetero Atom))

Section cross-reference(s): 24

ST butanediol; THF; hydrogenation butyrolactone gas phase

IT Hydrogenation catalysts

(copper/silicon or copper/chromium/manganese or copper/chromium/manganese/barium, for butyrolactone)

IT 7439-96-5, Manganese, uses and miscellaneous

RL: USES (Uses)

(catalyst containing copper and chromium and, for hydrogenation of butyrolactone)

IT 7440-47-3, Chromium, uses and miscellaneous

RL: USES (Uses)

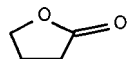
(catalyst containing copper and manganese and, for hydrogenation of butyrolactone)

IT 7440-21-3, Silicon, uses and miscellaneous

RL: USES (Uses)

(catalyst containing copper and, for hydrogenation of

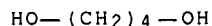
- butyrolactone)
- IT 7440-39-3, Barium, uses and miscellaneous  
RL: USES (Uses)  
(catalyst containing copper, chromium, and manganese and, for hydrogenation of butyrolactone)
- IT 7440-50-8, Copper, uses and miscellaneous  
RL: USES (Uses)  
(catalyst containing silicon and, for hydrogenation of butyrolactone)
- IT 96-48-0  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation of, catalyst containing copper/silicon or copper/chromium/manganese or copper/chromium/manganese/barium for)
- IT 108-31-6, Maleic anhydride, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation of, copper/manganese/chromium or nickel catalyst for)
- IT 109-99-9P, Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: SPN (Synthetic preparation); PREP (Preparation)  
(preparation of, by hydrogenation of butyrolactone, catalyst containing copper/silicon or copper/chromium/manganese or copper/chromium/manganese/barium for)
- IT 96-48-0  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrogenation of, catalyst containing copper/silicon or copper/chromium/manganese or copper/chromium/manganese/barium for)
- RN 96-48-0 HCAPLUS
- CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



- IT 109-99-9P, Tetrahydrofuran, preparation 110-63-4P, 1,4-Butanediol, preparation  
RL: SPN (Synthetic preparation); PREP (Preparation)  
(preparation of, by hydrogenation of butyrolactone, catalyst containing copper/silicon or copper/chromium/manganese or copper/chromium/manganese/barium for)
- RN 109-99-9 HCAPLUS
- CN Furan, tetrahydro- (CA INDEX NAME)



- RN 110-63-4 HCAPLUS
- CN 1,4-Butanediol (CA INDEX NAME)



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ACCESSION NUMBER: 1959:83380 HCAPLUS Full-text

DOCUMENT NUMBER: 53:83380

ORIGINAL REFERENCE NO.: 53:15048e-i,15049a-i,15050a-i,15051a

TITLE: Utilization of furfural as initial substance in the plastic industry

AUTHOR(S): Moshkin, P. A.

SOURCE: Voprosy Ispol'zovan. Pentozansoderzhashchego Syr'ya, Trudy Vsesoyuz. Soveshchaniya, Riga (1958), Volume Date 1955 225-54

DOCUMENT TYPE: Journal

LANGUAGE: Unavailable

AB The process of continuous hydrogenation under pressure was carried out in an apparatus in which H was introduced into a receiver working under 0.5-atmospheric excess pressure; upon increasing the pressure above a determined value, the feeding line closed automatically, and when the pressure fell to 0.1 atmospheric, the compressor also stopped automatically, forcing H into 2 buffers at 400 atmospheric; one of the buffers served to feed H to the continuously working device mounted separately; the substance to be hydrogenated was forced into the mixing 3-way pipe by means of a high-pressure pump and H was introduced from the buffer; the mixture was directed into 2 0.5-1. tubes filled with suitable catalysts and fitted with a 3-zone elec. furnace (manometers and heat gages were installed at different points); the product, after passing through the reactor, was cooled in a condenser and collected in a receiver-separator out of which H entered the atmospheric through a throttle valve and a gas counter; the hydrogenation product also passed through a throttle valve into a collector at atmospheric pressure. A continuous process for obtaining furyl alc. (I) was developed by using the above apparatus in which Cu chromite, stabilized with alkaline earth metal oxides, was used as a catalyst. This catalyst was also found to be most suitable for the hydrogenation of carbonyl groups or in similar cases, e.g., the hydrogenation of hydroxyvaleric aldehyde in pentanediol (in this case, by a batch process). The hydrogenation of furan (II) to yield tetrahydrofuran (III) was carried out by introducing it together with H in the tubular reactor filled with skeletal Ni; heating was accomplished by circulating a liquid heated to constant temperature (aqueous ethylene glycol (IV) with a constant b.p.). The continuous process of hydrogenation of nitriles into amines (e.g. the dinitrile of adipic acid) was carried out to give 85% basic products on skeletal Co, in MeOH saturated with NH<sub>4</sub>OH. The yield of nitrites prepared from chlorides by the action of alkali metal cyanides was increased by working at atmospheric pressure, but by using high-boiling solvents, e.g., aqueous glycol for the preparation of dinitriles from dichlorobutane (V) and dichlorodibutyl ether (VI), adiponitrile in the preparation of chlorovaleronitrile, and glycerol in the synthesis of the nitrile of hydroxycaproic acid. In all cases the yield was remarkably increased. The esterification of chlorides for obtaining the complex esters required in the plastic industry was used successfully with salts of fatty acids. Furfural (VII) obtained from the peat industry was quite unsuitable for the synthesis of "semi-products." VII obtained from the hydrolysis of resinous wood was not used either, owing to the presence (even in small quantities) of compds. of the terpene series which cause the formation of resins. The hydrogenation of VII into tetrahydrofuryl alc. (VIII) was carried out in 2 stages, and satisfactory results were obtained at 95-100°, under a pressure of 100 atmospheric, and a volume rate of 0.12-0.3, during 350 hrs.; under these conditions the moist product contained 97-8% I and the content of VII did not exceed 0.2%. I was then converted into VIII (yield 78%) by the batch process

at 130-5°, under a pressure of 100 atmospheric with Ni on Cr oxide as the catalyst, or by the continuous process at 120-5°, 100 atmospheric, with Ni on Cr oxide, and a volume rate of 0.2. The crude hydride was obtained in a 100% yield (on the weight of I) and contained 90% VIII and 0.2-0.3% I. VIII, b. 177-8°, d. 1.050, n 1.4502, was mostly used in further syntheses: VIII with SOCl<sub>2</sub> in the presence of C<sub>5</sub>H<sub>5</sub>N yielded 75% tetrahydrofurfuryl chloride (IX), b<sub>7-8</sub> 37-8°, d<sub>20</sub> 1.1112, n<sub>20D</sub> 1.4556. IX with NaNH<sub>2</sub> in liquid NH<sub>3</sub> yielded 65% 4-pentyn-1-ol (X), b<sub>9</sub> 47°, d<sub>20</sub> 0.9132, n<sub>20D</sub> 1.4455, hydroxyl number 19.7. X in the presence of CuCl and NH<sub>4</sub>Cl was oxidized in an aqueous solution of O of the air into 95% 4,6-decadiyne-1,10-diol which in its turn, with Raney Ni catalyst at room temperature and atmospheric pressure yielded 1,10-decanediol in a quant. yield; the oxidation of this diol with HNO<sub>3</sub> yielded 80% sebacic acid. The dehydration and the simultaneous isomerization of VIII carried out at 340-60° over activated Al<sub>2</sub>O<sub>3</sub> (obtained by treating γ-Al<sub>2</sub>O<sub>3</sub> with HNO<sub>3</sub> and heating 4 hrs. at 450°) with a volume rate of 1.23 yielded 85% dihydropyran (XI), b<sub>760</sub> 86°, d<sub>20</sub> 0.923, soluble in H<sub>2</sub>O (3% at room temperature) and in most organic compds. XI reacted easily with various substances like alcs., glycols, mercaptans, organic acids, and added Cl, H, HCl, COCl<sub>2</sub>, or H<sub>2</sub>O; in the presence of traces of mineral acid XI with VIII yielded 85% product, b<sub>15</sub> 124-6°, d<sub>20</sub> 1.046, n<sub>20D</sub> 1.4591, a selective solvent of a few inorg. compds., and yielded with IV a liquid, b<sub>12</sub> 187-8°, d<sub>20</sub> 1.073, n<sub>20D</sub> 1.4622. XI heated with H<sub>2</sub>O at 50° in the presence of traces of mineral acid yielded 87% δ-hydroxyvaleric aldehyde (XII), b<sub>2</sub> 51-2°, d<sub>20</sub> 1.053, n<sub>20D</sub> 1.4510, soluble in H<sub>2</sub>O. XII hydrogenated over Cu-Cr catalyst at 130° under a pressure of 150 atmospheric yielded 92% 1,5-pentanediol (XIII), odorless viscous liquid, b<sub>3</sub> 119-20°, d<sub>20</sub> 0.989, n<sub>20D</sub> 1.4470. XI under a pressure of 40-60 atmospheric and at 110-15° in the presence of Ni over Cr oxide yielded 95% of tetrahydropyran (XIV), b<sub>760</sub> 87-8°, d<sub>20</sub> 0.881, n<sub>20D</sub> 1.4211, soluble in H<sub>2</sub>O (approx. 95% at 20°). In the vapor phase, the hydrogenation of XI under atmospheric pressure and at 120-30° with a volume rate of 0.2-0.25 over skeletal Ni yielded only 85% XIV. XIV with SOCl<sub>2</sub> at 105-10° in the presence of ZnCl<sub>2</sub> yielded 50-55% 1,5-dichloropentane (XV) accompanied by much resin formation. XIV boiled with AcCl, 5 hrs., yielded 93-5% chloropentanol (XVI) acetate, b<sub>15</sub> 100-3°, d<sub>20</sub> 1.053, n<sub>20D</sub> 1.4360, which on being reesterified with MeOH yielded 94% of XVI, b<sub>12</sub> 98-9°, d<sub>20</sub> 1.049, n<sub>20D</sub> 1.4510. XVI with SOCl<sub>2</sub> at 130° yielded 80% XV, b<sub>14</sub> 69-71°, d<sub>20</sub> 1.093, n<sub>20D</sub> 1.4530; this roundabout way permitted increasing the yield of XV to 72% calculated on XIV. The action of cyanides and alkali metals on XVI at 125° in aqueous glycerol, 2 hrs., yielded 85% of the nitrile of hydroxycaproic acid, b<sub>20</sub> 150-2°, d<sub>20</sub> 0.970, n<sub>20D</sub> 1.4470, which was reduced in a NH<sub>4</sub>OH-alc. solution at 50° and 50-70 atmospheric with Raney Ni as catalyst to yield 73% aminohexanol, m. 50-1°, b<sub>5</sub> 118-20°. XIV oxidized by HNO<sub>3</sub> (d. 1.32) at a temperature below 25° yielded 87% glutaric acid, m. 97.5°, soluble in H<sub>2</sub>O and alc. The action of Ac<sub>2</sub>O on VII in the presence of AcOK at 135-40° yielded the K salt of furylacrylic acid (XVII); the K salt in its turn yielded 65% XVII, m. 139.5°, acid number 401. Acetaldehyde was condensed with VII in 1% NaOH at 30° to yield 80% of the anhydride of XVII, m. 49-50°, b<sub>10</sub> 95-102°, which could not be oxidized to give the acid. A dry current of HCl was passed into an alc. solution of XVII at 100° to yield the ester of oxopimelic acid (XVIII). Other esters (di-Et, di-Pr, di-Bu) were also obtained. The esters of XVIII saponified more easily in an alkaline medium than in an acid medium. The synthesis of II consisted in the removal of a carbonyl group from the mol. of VII at 400-20° over a mixture of the oxides of Zn, Cr, and Mn in molar ratio 7:5:1 (mixed with graphite in the form of 4 + 4 mm. tablets) with a volume rate of 0.3; simultaneously with VII water/vapor was added in the ratio 1:2.5; the reaction mixture contained CO<sub>2</sub>, H, and 95% II; the catalyst lost its activity after 50-5 hrs. and had to be regenerated; this was done in the same apparatus by blowing air 5-6 hrs. at a temperature not above 550°, and a subsequent treatment with H. II was hydrogenated by bringing the reaction mixture (without any previous separation) over molten Ni catalyst at about 120° with a volume rate of 0.12, and cooling in Dry Ice to

yield 90% III. After the separation of IV by simply cooling with H<sub>2</sub>O, the gases were recirculated. VI formed an azeotropic mixture with H<sub>2</sub>O (b. 63°) and contained 95% III. The ring of III was opened rather easily by the action of AcCl at 50°, upon cooling, to give 90% chlorobutanol acetate, b<sub>3.5</sub> 72-5°, d<sub>20</sub> 1.0852, n<sub>20D</sub> 1.4360; this, treated with AcOK at 160-70° yielded butanediol diacetate (XIX), b. 230°, d<sub>20</sub> 1.0460, n<sub>20D</sub> 1.4220. XIX could also be obtained in a 62% yield directly from III by the action of Ac<sub>2</sub>O in the presence of H<sub>2</sub>SO<sub>4</sub> at 93° (the temperature gradually rising to 145°) and the subsequent distillation of the excess Ac<sub>2</sub>O and AcOH formed. XIX reesterified with MeOH in the presence of a small amount HCl (3% on alc.) at 65-70° yielded AcOMe and 90% butanediol (XX), m. 18.5°, b<sub>760</sub> 230°, d<sub>20</sub> 1.021, n<sub>20D</sub> 1.4460. The opening of the ring of III in the continuous process by the action of SOCl<sub>2</sub> and CoCl<sub>2</sub> at 100-2° yielded 30-80% V, b<sub>13</sub> 48-50°, d<sub>20</sub> 1.128, n<sub>20D</sub> 1.4520, and 60-14% dichlorobutyl ester, b<sub>13</sub> 126-8°, d<sub>20</sub> 1.0747, n<sub>20D</sub> 1.4568. V with alkali metal cyanides was converted at 140° in an aqueous solution (85%) of IV in the presence of a small amount of KI into 81% adiponitrile, d<sub>20</sub> 0.9531, n<sub>20D</sub> 1.4340, which by saponification in an alkaline or an acid medium yielded 85% adipic acid, m. 150-1°. Hexamethylene diamine was obtained in a 85% yield by the hydrogenation of adiponitrile at 85-90° under a pressure of 100 atmospheric with a volume rate of 0.3 over molten Co catalyst in a NH<sub>3</sub> alc. solution. The preparation of ethers was accomplished by the interaction of V or VI with the dry Na salts of the synthetic fatty acids containing 7-9 C atoms in a medium consisting of the same free acids at 180-90°, 14 hrs., by washing with acidified H<sub>2</sub>O, and distilling. The action of alkali metal cyanide on VI at elevated temperature in an aqueous IV medium yielded 80% hydroxydivaleric acid (XXI) dinitrile, b<sub>5</sub> 175-80°, d<sub>20</sub> 0.963, n<sub>20D</sub> 1.4459. The alkaline saponification of XXI dinitrile yielded 77% XXI, m. 85-6°, and from XXI itself an ether b<sub>3</sub> 237-39°, d<sub>20</sub> 0.9353, n<sub>20D</sub> 1.4499, and saponification number 256, was obtained. The reduction of XXI dinitrile in an NH<sub>3</sub>-alc. solution at 100° over Raney Ni yielded 76% 5,5-di-(aminoamyl) ether, b. 135-7°, d<sub>20</sub> 0.9330, n<sub>20D</sub> 1.4627. VI heated with K phthalimide with the subsequent decomposition of the obtained product yielded 70% 4,4'-di(aminobutyl)ether, b<sub>9</sub> 125-6°, n<sub>20D</sub> 1.4568. VI treated with AcOK at 170-80° yielded 90% dibutylenglycol(XXII) diacetate, b<sub>4</sub> 147-50°, d<sub>20</sub> 1.0253, n<sub>20D</sub> 1.4340, which reesterified with MeOH as above for XX yielded 92% XXII, b<sub>4</sub> 140-1°, d<sub>20</sub> 1.0041, n<sub>20D</sub> 1.4537. The substitution of one Cl in V by a cyano group in a solution of adiponitrile at 135-40° yielded 62% chlorovaleronitrile, b<sub>28</sub> 115-17°, d<sub>20</sub> 1.0536, n<sub>20D</sub> 1.4430, which treated with Na<sub>2</sub>S in an aqueous solution of IV at 115-20° yielded 70% thiodivaleric acid dinitrile (XXIII), b<sub>3</sub> 189-90°, d<sub>20</sub> 1.023, n<sub>20D</sub> 1.4868. The saponification of XXIII in an acid medium yielded 75% thiovaleric acid, m. 94-5°. The oxidation of III by HNO<sub>3</sub> at below 25-30° yielded 90% succinic acid (XXIV), m. 183°. The oxidation under less severe conditions, e.g. in HNO<sub>3</sub> (d. 1.34) at 20-8° in C<sub>6</sub>H<sub>6</sub> yielded 37% butyrolactone (XXV), b. 198-20°, d<sub>20</sub> 1.298, n<sub>20D</sub> 1.4350, and XXIV. XXV was also obtained by the dehydrogenation of XX over Cu-Cr catalyst at 230-40° (yield: 95%). The characteristics of a number of complex esters obtained from the products of VII are given in the order: name of acid, name of alc., b.p., d<sub>20</sub>, n<sub>20D</sub>, saponification number, flash p., specific volume resistance (ohm/cm.), losses on heating 6 hrs. at 100 (%), stability to freezing of the poly(vinyl chloride) films in degrees: XXIV, 2-ethylhexyl alc. (XXVI), 176-8° (25), 0.930, 1.4420, 333, 186, 2.4 + 1010, 0.2, -25°; XXIV, alcs. with Cl<sub>2</sub>, 220-5° (2), 0.915, 1.4499, 256, 225, 3.2 + 1011, 0.25, -30°; glutaric acid, XXVI, -, 0.926, 1.4465, 320.7, 181, 4.7 + 10, -, -35°; adipic acid, XXVI, -, 0.924, 1.4467, 301.7, 197, 8.7 + 1010, 0.5, -45°; adipic acid, VIII, -, 1.121, 1.4710(25), 364, 199, 2.3 + 109, 0.41, -35°; XVIII, XXVI, -, 0.961, 1.4530, 385, 197, 7.3 + 1010, 0.35, -50°; sebacic acid, VIII, -, 1.067, 1.4680(25), 298, 218, 7.3 + 109, 0.15, -25°; phthalic acid, VIII, -, 1.205(25), 1.5230, 320, 210, 4.4 + 109, 0.23, -; XX, XXVI, 237-9(3), 0.935, 1.4499, 256, 225, 3.2 + 1011, 0.25, -30°; C7-C9 acids, XX, 200-35° (5), 0.925, 1.4449, 312, 197, 4.5 + 1011, 0.07, -58°; C7-C9 acids, XXII, 220-90° (5), 0.936, 1.4482, 283, 212,



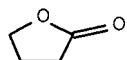
- 4.5 + 1010, 0.016, -50°; oleic acid, VIII, 222-7°(2), 0.922(25), 1.4655(25), 147-55, 196, 2 + 1011, 0.35, -50°; tetrahydrofurancarboxylic acid (XXVII), XXVI, 117-20°(4), 0.9645, 1.4470, 244.2, -, -, -, -; XXVII; diethylene glycol, 216-18°(3), 1.1921, 1.4684, 376.6, -, -, -, -.
- CC 10G (Organic Chemistry: Heterocyclic Compounds)
- IT Hydrogenation  
(of furan and derivs.)
- IT 1,4-Butanediol, diacetate  
RL: PREP (Preparation)
- IT 110-00-9, Furan  
(and derivs., hydrogenation of)
- IT 109-99-9P, Furan, tetrahydro-  
RL: PREP (Preparation)  
(formation of, from furan)
- IT 96-48-0P, Butyrolactone  
RL: PREP (Preparation)  
(formation of, from succinic acid)
- IT 97-99-4P, Furfuryl alcohol, tetrahydro- 98-00-0P, Furfuryl alcohol  
110-15-6P, Succinic acid 110-56-5P, Butane, 1,4-dichloro-  
110-63-4P, 1,4-Butanediol 110-87-2P, 2H-Pyran, 3,4-dihydro-  
110-94-1P, Glutaric acid 111-20-6P, Sebacic acid 111-29-5P,  
1,5-Pentanediol 111-69-3P, Adiponitrile 112-47-0P, 1,10-Decanediol  
124-04-9P, Adipic acid 124-09-4P, 1,6-Hexanediamine 142-68-7P, Pyran,  
tetrahydro- 539-47-9P, 2-Furanacrylic acid 628-76-2P, Pentane,  
1,5-dichloro- 928-88-1P, 1-Butanol, 4,4'-oxydi-, diacetate 2453-48-7P,  
Hexanenitrile, 6-hydroxy- 2915-57-3P, Succinic acid, bis(2-ethylhexyl)  
ester 3003-84-7P, Furan, 2-(chloromethyl)tetrahydro- 3388-01-0P,  
Phthalic acid, bis(tetrahydrofurfuryl) ester 3403-82-5P, 1-Butanol,  
4,4'-oxydi- 4048-33-3P, 1-Hexanol, 6-amino- 4221-03-8P, Valeraldehyde,  
5-hydroxy- 4650-79-7P, Sebacic acid, bis(tetrahydrofurfuryl) ester  
5259-98-3P, 1-Pentanol, 5-chloro- 5390-04-5P, 4-Pentyn-1-ol  
5392-06-3P, Valeronitrile, 5,5'-oxydi- 5420-17-7P, Oleic acid,  
tetrahydrofurfuryl ester 6280-87-1P, Valeronitrile, 5-chloro-  
6334-96-9P, Ether, bis(4-chlorobutyl) 6962-92-1P, 1-Butanol, 4-chloro-,  
acetate 7423-51-0P, Valeric acid, 5,5'-oxydi- 7426-79-1P, Pentylamine,  
5,5'-oxybis- 10341-17-0P, Valeric acid, 5,5'-thiodi- 20395-28-2P,  
1-Pentanol, 5-chloro-, acetate 21302-20-5P, Glutaric acid,  
bis(2-ethylhexyl) ester 42968-72-9P, Butylamine, 4,4'-oxybis-  
67998-15-6P, 2-Furanacrylic anhydride 70283-74-8P, 4,6-Decadiyne-1,10-  
diol 91006-13-2P, Valeronitrile, 5,5'-thiodi- 99183-75-2P, Diethylene  
glycol, tetrahydro-2-furoate 103043-67-0P, Valeric acid, 5,5'-oxydi-,  
bis(2-ethylhexyl) ester 117071-05-3P, 2-Furanacrylic acid, potassium  
salt  
RL: PREP (Preparation)  
(preparation of)
- IT 109-99-9P, Furan, tetrahydro-  
RL: PREP (Preparation)  
(formation of, from furan)
- RN 109-99-9 HCAPLUS
- CN Furan, tetrahydro- (CA INDEX NAME)



- IT 96-48-0P, Butyrolactone  
RL: PREP (Preparation)

(formation of, from succinic acid)

RN 96-48-0 HCAPLUS  
 CN 2(3H)-Furanone, dihydro- (CA INDEX NAME)



IT 110-63-4P, 1,4-Butanediol  
 RL: PREP (Preparation)  
 (preparation of)  
 RN 110-63-4 HCAPLUS  
 CN 1,4-Butanediol (CA INDEX NAME)

HO—(CH<sub>2</sub>)<sub>4</sub>—OH

=&gt; d que 152

L1 167 SEA FILE=REGISTRY ABB=ON PLU=ON C4H10O2/MF  
 L2 90 SEA FILE=REGISTRY ABB=ON PLU=ON L1 AND ?DIOL?/CNS  
 L3 1 SEA FILE=REGISTRY ABB=ON PLU=ON BUTANEDIOL/CN  
 L4 90 SEA FILE=REGISTRY ABB=ON PLU=ON L2 OR L3  
 L5 23645 SEA FILE=REGISTRY ABB=ON PLU=ON (101021-58-3/CRN OR 101021-60-7/CRN OR 107-88-0/CRN OR 110-63-4/CRN OR 110-71-4/CRN OR 114794-46-6/CRN OR 117373-32-7/CRN OR 117373-33-8/CRN OR 119567-52-1/CRN OR 119567-53-2/CRN OR 127032-47-7/CRN OR 127032-49-9/CRN OR 136707-56-7/CRN OR 136779-42-5/CRN OR 138885-86-6/CRN OR 144831-21-0/CRN OR 14848-89-6/CRN OR 159806-32-3/CRN OR 160961-49-9/CRN OR 168011-04-9/CRN OR 179679-50-6/CRN OR 179913-51-0/CRN OR 19132-06-0/CRN OR 2163-42-0/CRN OR 219473-96-8/CRN OR 219473-97-9/CRN OR 219925-61-8/CRN OR 23554-34-9/CRN OR 24347-58-8/CRN OR 24621-61-2/CRN OR 25265-75-2/CRN OR 26466-25-1/CRN OR 286012-95-1/CRN OR 28795-91-7/CRN OR 287963-01-3/CRN OR 339267-04-8/CRN OR 339267-05-9/CRN OR 344328-83-2/CRN OR 344750-80-7/CRN OR 347841-77-4/CRN OR 36684-44-3/CRN OR 38274-25-8/CRN OR 39495-74-4/CRN OR 40348-66-1/CRN OR 41240-66-8/CRN OR 43044-32-2/CRN OR 495384-83-3/CRN OR 50410-66-7/CRN OR 513-85-9/CRN OR 5341-95-7/CRN OR 554429-16-2/CRN OR 558-43-0/CRN OR 584-03-2/CRN OR 58735-88-9/CRN OR 62064-81-7/CRN OR 6290-03-5/CRN OR 67057-67-4/CRN OR 67057-69-6/CRN OR 68344-06-9/CRN OR 68972-45-2/CRN OR 6982-25-8/CRN OR 70969-15-2/CRN OR 71760-76-4/CRN OR 71764-39-1/CRN OR 72271-58-0/CRN OR 73522-17-5/CRN OR 74829-49-5/CRN OR 75156-26-2/CRN OR 76490-88-5/CRN OR 79562-77-9/CRN OR 79562-82-6/CRN OR 79864-96-3/CRN OR 799775-81-8/CRN OR 80404-89-3/CRN OR 80902-18-7/CRN OR 84803-08-7/CRN OR 84803-09-8/CRN OR 84868-09-7/CRN OR 84868-10-0/CRN OR 86688-15-5/CRN OR 871313-10-9/CRN OR 87876-53-7/CRN OR 87876-58-2/CRN OR 87876-59-3/CRN OR 89268-43-9/CRN OR 91314-21-5/CRN OR 942519-61-1/CRN OR 97825-34-8/CRN OR 99441-00-6/CRN OR 99801-86-2/CRN) OR L4  
 L6 2 SEA FILE=REGISTRY ABB=ON PLU=ON GBL/CN

L10 25 SEA FILE=REGISTRY ABB=ON PLU=ON (1344-28-1/BI OR 108-30-5/BI OR 109-99-9/BI OR 110-16-7/BI OR 1304-28-5/BI OR 1305-78-8/BI OR 1306-38-3/BI OR 1309-48-4/BI OR 1312-81-8/BI OR 1314-11-0/BI OR 1314-13-2/BI OR 1314-23-4/BI OR 1317-34-6/BI OR 1317-38-0/BI OR 1333-74-0/BI OR 13463-67-7/BI OR 14635-75-7/BI OR 25265-75-2/BI OR 67-66-3/BI OR 7440-44-0/BI OR 7631-86-9/BI OR 7732-18-5/BI OR 9016-00-6/BI OR 9052-19-1/BI OR 96-48-0/BI)

L11 1 SEA FILE=REGISTRY ABB=ON PLU=ON L10 AND L6

L12 314 SEA FILE=REGISTRY ABB=ON PLU=ON 96-48-0/CRN OR L11

L13 1 SEA FILE=REGISTRY ABB=ON PLU=ON TETRAHYDROFURAN/CN

L14 8024 SEA FILE=REGISTRY ABB=ON PLU=ON L13 OR 109-99-9/CRN

L15 353 SEA FILE=REGISTRY ABB=ON PLU=ON C4H8O/MF

L16 18 SEA FILE=REGISTRY ABB=ON PLU=ON L15 AND OC4/ES

L17 8063 SEA FILE=REGISTRY ABB=ON PLU=ON (109-99-9/CRN OR 120089-77-2/CRN OR 135008-66-1/CRN OR 153172-62-4/CRN OR 1693-74-9/CRN OR 20665-63-8/CRN OR 243855-45-0/CRN OR 2717-68-2/CRN OR 34475-13-3/CRN OR 68383-93-7/CRN OR 70969-13-0/CRN OR 758674-46-3/CRN OR 775273-86-4/CRN OR 87174-62-7/CRN OR 87174-63-8/CRN OR 87174-64-9/CRN OR 89268-44-0/CRN OR 97807-15-3/CRN) OR L16

L18 8063 SEA FILE=REGISTRY ABB=ON PLU=ON L17 OR L14

L37 41 SEA FILE=HCAPLUS ABB=ON PLU=ON ("ROSCH M"/AU OR "ROSCH M W"/AU OR "ROSCH MARKUS"/AU)

L38 121 SEA FILE=HCAPLUS ABB=ON PLU=ON ("PINKOS ROLF"/AU OR "PINKOS ROLF DR"/AU)

L39 300 SEA FILE=HCAPLUS ABB=ON PLU=ON ("HESSE M"/AU OR "HESSE M A"/AU OR "HESSE M B"/AU OR "HESSE M D"/AU OR "HESSE M E"/AU OR "HESSE M G L"/AU OR "HESSE MICHAEL"/AU)

L40 33 SEA FILE=HCAPLUS ABB=ON PLU=ON ("SCHLITTER STEPHAN"/AU OR "SCHLITTER STEPHAN M"/AU)

L41 30 SEA FILE=HCAPLUS ABB=ON PLU=ON ("JUNICKE H"/AU OR "JUNICKE HENRIK"/AU)

L42 15 SEA FILE=HCAPLUS ABB=ON PLU=ON ("SCHUBERT O"/AU OR "SCHUBERT O E"/AU OR "SCHUBERT OLGA"/AU)

L43 45 SEA FILE=HCAPLUS ABB=ON PLU=ON ("WECK A"/AU OR "WECK A L DE"/AU OR "WECK ALEXANDER"/AU)

L44 17 SEA FILE=HCAPLUS ABB=ON PLU=ON ("WINDECKER G"/AU OR "WINDECKER R GUNTHER"/AU)

L45 524 SEA FILE=HCAPLUS ABB=ON PLU=ON (L37 OR L38 OR L39 OR L40 OR L41 OR L42 OR L43 OR L44)

L46 133 SEA FILE=HCAPLUS ABB=ON PLU=ON L45 AND ?HYDROGENAT?

L47 43 SEA FILE=HCAPLUS ABB=ON PLU=ON L46 AND (L5 OR L12 OR L18)

L48 8 SEA FILE=HCAPLUS ABB=ON PLU=ON L47 AND ?DISTIL?

L49 42 SEA FILE=HCAPLUS ABB=ON PLU=ON L47 AND (PREP+NT/RL OR PREPAR? OR SYNTH?)

L50 12 SEA FILE=HCAPLUS ABB=ON PLU=ON L49 AND REACTOR?

L51 7 SEA FILE=HCAPLUS ABB=ON PLU=ON L49 AND ?STREAM?

L52 21 SEA FILE=HCAPLUS ABB=ON PLU=ON L48 OR L50 OR L51

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L52 ANSWER 1 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2007:61277 HCAPLUS Full-text  
 DOCUMENT NUMBER: 146:144695  
 TITLE: Method for the hydrogenation of streams containing aldehydes  
 INVENTOR(S): Pinkos, Rolf; Tebben, Gerd-Dieter; Hauk, Alexander; Mueller, Christian; Rust, Harald  
 PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany  
 SOURCE: PCT Int. Appl., 27pp.

CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2007006789	A1	20070118	WO 2006-EP64115	20060711
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM DE 102005032541 A1 20070118 DE 2005-102005032541 20050712 PRIORITY APPLN. INFO.: DE 2005-102005032541A 20050712				

OTHER SOURCE(S): CASREACT 146:144695

AB The invention relates to a method for reacting a continuous stream of an unsatd. organic compound such as cyclododeca-4,8-dien-1-one containing at least one aldehyde impurity with hydrogen in the presence of a catalyst in at least one main reactor and at least one subsequent reactor, whereby at least 50% of the fresh hydrogen that is fed to the reaction system is supplied to at least one subsequent reactor. According to a preferred embodiment, the steam contains at least one addnl. organic compound impurity. This process provides improved conversion from impure unsatd. compds.

REFERENCE COUNT: 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 2 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2006:795527 HCAPLUS Full-text

DOCUMENT NUMBER: 145:188707

TITLE: Method for controlling hydrogenation processes

INVENTOR(S): Weck, Alexander; Roesch, Markus;  
 Windecker, Gunther; Heydrich, Gunnar;  
 Pinkos, Rolf; Schubert, Olga; Harth, Klaus

PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 23pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2006082165	A1	20060810	WO 2006-EP50507	20060130
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE,				

SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,  
 VN, YU, ZA, ZM, ZW  
 RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE,  
 IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ,  
 CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH,  
 GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY,  
 KG, KZ, MD, RU, TJ, TM

DE 102005004604 A1 20060810 DE 2005-102005004604 20050201

PRIORITY APPLN. INFO.: DE 2005-102005004604A 20050201

AB In a method for controlling the hydrogenation of an alkene (e.g., maleic anhydride into succinic anhydride) in a hydrogenation reactor, the amount of hydrogen reacted during hydrogenation is determined first, whereupon the ratio between the amount of hydrogen reacted and the amount of alkene delivered is calculated, said ratio is compared to a predefined setpoint value, and finally at least one process parameter is modified if the ratio between the amount of hydrogen reacted and the amount of alkene delivered deviates from the predefined setpoint value by a given value. Process flow diagrams are presented.

REFERENCE COUNT: 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 3 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2006:635061 HCAPLUS Full-text

DOCUMENT NUMBER: 145:82086

TITLE: Production of pyrrolidones from fermentation broth succinate salts

INVENTOR(S): Fischer, Wolfgang; Klein, Daniela; Kuenkel, Andreas; Pinkos, Rolf; Scholten, Edzard

PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 32 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2006066839	A2	20060629	WO 2005-EP13630	20051217
WO 2006066839	A3	20060831		

W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW

RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

EP 1831163 A2 20070912 EP 2005-821674 20051217

R: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LI, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR

PRIORITY APPLN. INFO.: DE 2004-102004062717A 20041221

WO 2005-EP13630 W 20051217

OTHER SOURCE(S): CASREACT 145:82086; MARPAT 145:82086

AB A process is provided for the production of succinimide and related compds. by reactive distillation of succinate salts found in fermentation broth.

L52 ANSWER 4 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2005:570881 HCAPLUS Full-text

DOCUMENT NUMBER: 143:78656

TITLE: Method for the production of defined mixtures of THF, butanediol and  $\gamma$ -butyrolactone by catalytic gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivatives

INVENTOR(S): Roesch, Markus; Pinkos, Rolf; Hesse, Michael; Schlitter, Stephan; Junicke, Henrik; Schubert, Olga; Weck, Alexander; Windecker, Gunther

PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 28 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005058853	A2	20050630	WO 2004-EP13811	20041204
WO 2005058853	A3	20050804		
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				
RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
DE 10357715	A1	20050714	DE 2003-10357715	20031209
EP 1694662	A2	20060830	EP 2004-803523	20041204
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, FI, RO, CY, TR, BG, CZ, EE, HU, PL, SK, IS				
CN 1890231	A	20070103	CN 2004-80036825	20041204
JP 2007516970	T	20070628	JP 2006-543447	20041204
US 2007135650	A1	20070614	US 2006-581074	20060531
PRIORITY APPLN. INFO.:				
			DE 2003-10357715	A 20031209
			WO 2004-EP13811	W 20041204

AB Mixts. of optionally alkyl-substituted THF, butanediol, and  $\gamma$ -butyrolactone are prepared by two-stage gas-phase hydrogenation where: (A) a gas flow of C4 dicarboxylic acids (e.g., maleic acid) and/or the derivs. is hydrogenated in a first stage in the gaseous phase on a catalyst at 200-300°/2-100 bars in a first reactor over a catalyst in the form of molded bodies with a volume of <20 mm<sup>3</sup> consisting of 5-95% Cu oxide and 5-95% of an oxide with acid centers in order to form a flow mainly consisting of optionally aryl-substituted  $\gamma$ -butyrolactone and THF; (B) succinic anhydride is separated by partial condensation; (C) THF, water, and  $\gamma$ -butyrolactone, which remain in the gaseous phase during the partial condensation, are hydrogenated at 150-240° at the same or lower pressure to reduce flow losses in the hydrogenation circuit in a second reactor over a catalyst of  $\geq 95\%$  CuO and 5-95% of  $\geq 1$  of ZnO, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, TiO<sub>2</sub>, ZrO<sub>2</sub>, CeO<sub>2</sub>, MgO, CaO, SrO, BaO, La<sub>2</sub>O<sub>3</sub>, and Mn<sub>2</sub>O<sub>3</sub> to form THF,

butanediol and  $\gamma$ -butyrolactone; (D) hydrogen is separated from the products and recycled; and (E) the products are separated by distillation

L52 ANSWER 5 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2005:564605 HCAPLUS Full-text  
 DOCUMENT NUMBER: 143:99268  
 TITLE: Improved catalyst for hydrogenating maleic  
 anhydride to form  $\gamma$ -butyrolactone and  
 tetrahydrofuran  
 INVENTOR(S): Roesch, Markus; Pinkos, Rolf; Hesse,  
 Michael; Schlitter, Stephan;  
 Schubert, Olga; Windecker, Gunther;  
 Weck, Alexander  
 PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany  
 SOURCE: PCT Int. Appl., 27 pp.  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005058492	A1	20050630	WO 2004-EP13810	20041204
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
DE 10357716	A1	20050714	DE 2003-10357716	20031209
PRIORITY APPLN. INFO.:			DE 2003-10357716	A 20031209
OTHER SOURCE(S):			CASREACT 143:99268	

AB Succinic anhydride-free mixts. of  $\gamma$ -butyrolactone (GBL) and THF are manufactured by use of Cr-free catalyst for gas-phase hydrogenation of C4-dicarboxylic acids and/or their derivs., e.g., maleic anhydride. The catalyst is provided in the form of shaped bodies, which comprise a mixture consisting of 5-95% Cu oxide and 5-95% of an oxide having acid centers, such as Al<sub>2</sub>O<sub>3</sub>. The volume of the individual shaped catalyst body is <20 mm<sup>3</sup>, preferably <6 mm<sup>3</sup>. The ratio of products THF and GBL to 1 another is set only by varying the temps. inside the reactor.

REFERENCE COUNT: 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 6 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2005:426550 HCAPLUS Full-text  
 DOCUMENT NUMBER: 142:464144  
 TITLE: Catalytic hydrogenation method for producing  
 1,4-butanediol from  $\gamma$ -butyrolactone in the  
 presence of water  
 INVENTOR(S): Roesch, Markus; Pinkos, Rolf; Junicke,  
 Henrik; Hesse, Michael; Schlitter,  
 Stephan; Weck, Alexander;

Windecker, Gunther  
 PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany  
 SOURCE: PCT Int. Appl., 24 pp.,  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2005044768	A1	20050519	WO 2004-EP12403	20041103
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW RW: BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG				
DE 10351697	A1	20050609	DE 2003-10351697	20031105
PRIORITY APPLN. INFO.:			DE 2003-10351697	A 20031105
AB A method is described for producing optionally alkyl-substituted 1,4- butanediol by the catalytic hydrogenation of a gas flow containing optionally alkyl-substituted $\gamma$ -butyrolactone on a catalyst in the gas phase comprising $\leq 95\%$ CuO, and $\geq 5\%$ of an oxidic carrier using a hydrogen gas stream containing preferably between 8-20% of water.				
REFERENCE COUNT: 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT				

L52 ANSWER 7 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2004:177937 HCAPLUS Full-text  
 DOCUMENT NUMBER: 140:218241  
 TITLE: Procedure for preparation of polyoxyalkylene  
 glycols or polyoxyalkylene glycol copolymers in high  
 yield and selectivity using hydrogenation  
 catalysts with high pot life  
 INVENTOR(S): Pinkos, Rolf; Hesse, Michael;  
 Haubner, Martin; Schlitter, Stephan  
 PATENT ASSIGNEE(S): BASF A.-G., Germany  
 SOURCE: Ger. Offen., 5 pp.  
 CODEN: GWXXBX  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 10238953	A1	20040304	DE 2002-10238953	20020824
WO 2004020498	A1	20040311	WO 2003-EP8405	20030730
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW				



RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY,  
 KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES,  
 FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR,  
 BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG

AU 2003258545 A1 20040319 AU 2003-258545 20030730  
 PRIORITY APPLN. INFO.: DE 2002-10238953 A 20020824  
 WO 2003-EP8405 W 20030730

AB The preparation of polyTHF (copolymers) by catalytic hydrogenation of the corresponding acyloxy group containing polymers is carried out at 150-210° and 30-330 bars in the presence of hydrogen, a basic component (such as oxides, hydroxides, carboxylates or alcoholates from alkali- or alkaline earth metals) and a catalyst prepared as molded product from an oxidic material comprising copper oxide, zinc oxide and aluminum oxide, mixed with powdered metallic copper and/or powdered concrete. Thus, a selectivity of 99.8% was calculated as result from a reaction of a 75:25 mixture of polyTHF diacetate and ethanol containing 100 ppm sodium ethanolate carried out in a 3.2 m reactor (diameter 1.5 cm) at 240 bars and 180° using a CuO/Cu/Zn/Al<sub>2</sub>O<sub>3</sub>, whereby the space-time yield was 0.2 kg polyTHF/L catalyst and h.

L52 ANSWER 8 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2003:991466 HCAPLUS Full-text

DOCUMENT NUMBER: 140:42669

TITLE: Method for the production of 1,4-butanediol by combined gas-phase and liquid-phase hydrogenation of C4 dicarboxylic acids or their derivatives

INVENTOR(S): Hesse, Michael; Schlitter, Stephan  
 ; Borchert, Holger; Schubert, Markus; Roesch, Markus;  
 Bottike, Nils; Fischer, Rolf-Hartmuth; Weck,  
 Alexander; Windecker, Gunther;  
 Heydrich, Gunnar

PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 37 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2003104176	A1	20031218	WO 2003-EP6057	20030610
W:			AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW	
RW:			GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG	
DE 10225927	A1	20031224	DE 2002-10225927	20020611
AU 2003274707	A1	20031222	AU 2003-274707	20030610
EP 1515935	A1	20050323	EP 2003-740211	20030610
R:			AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR, BG, CZ, EE, HU, SK	
CN 1659124	A	20050824	CN 2003-813350	20030610
JP 2005534658	T	20051117	JP 2004-511246	20030610

US 2005267318 A1 20051201 US 2004-516923 20041207  
 US 7169958 B2 20070130

## PRIORITY APPLN. INFO.:

DE 2002-10225927 A 20020611  
 WO 2003-EP6057 W 20030610

AB A method for the production of optionally alkyl-substituted 1,4-butanediol by a two-step catalytic gas-phase hydrogenation of C4-dicarboxylic acids and/or their derivs. is described comprising: (a) introduction of a gas flow of a C4-dicarboxylic acid or a derivative (e.g., maleic anhydride) into a first reactor and catalytic hydrogenation to form a mainly optionally alkyl-substituted  $\gamma$ -butyrolactone product; (b) conversion of the step (a) product flow into a liquid phase; (c) introduction of the obtained product flow into a second reactor and subjecting it to a catalytic liquid-phase hydrogenation to form optionally alkyl-substituted 1,4-butanediol; and (d) separation of the desired product from secondary products and unreacted feeds. In both hydrogenation steps, a CuO catalyst which consists of  $\leq 95\%$  of an oxidic carrier is used with a higher pressure prevailing in the second reactor than in the first reactor, and the product mixture taken from the first reactor is introduced into the second reactor without any other purification

REFERENCE COUNT: 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 9 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2003:991465 HCAPLUS Full-text

DOCUMENT NUMBER: 140:42668

TITLE: Two-stage hydrogenation method and catalyst for producing 1,4-butanediol from a C4 dicarboxylic acid with intermediate separation of succinic anhydride

INVENTOR(S): Hesse, Michael; Schlitter, Stephan  
 ; Borchert, Holger; Schubert, Markus; Roesch, Markus;  
 Bottke, Nils; Fischer, Rolf-hartmuth; Weck,  
 Alexander; Windecker, Gunther;  
 Heydrich, Gunnar

PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany; et al.

SOURCE: PCT Int. Appl., 40 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

## PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2003104175	A1	20031218	WO 2003-EP6100	20030611
W:	AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW			
RW:	GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG			
DE 10225929	A1	20031224	DE 2002-10225929	20020611
AU 2003242665	A1	20031222	AU 2003-242665	20030611
EP 1515933	A1	20050323	EP 2003-757057	20030611
R:	AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR, BG, CZ, EE, HU, SK			
CN 1668560	A	20050914	CN 2003-816533	20030611

JP 2005534657	T	20051117	JP 2004-511245	20030611
US 2006167323	A1	20060727	US 2004-516922	20041207
US 7271299	B2	20070918		

## PRIORITY APPLN. INFO.:

DE 2002-10225929	A	20020611
WO 2003-EP6100	W	20030611

AB A method for producing optionally alkyl-substituted 1,4-butanediol by the two-stage catalytic hydrogenation of C4 dicarboxylic acids and/or their derivs., in the gas phase, is described. This method comprises: (a) introduction of a gaseous stream of a C4 dicarboxylic acid or a derivative at 200-300°/2-60 bar into a first reactor and a catalytic gaseous phase hydrogenation to form a product containing  $\gamma$ -butyrolactone that is optionally alkyl-substituted; (b) separation of succinic anhydride from the product obtained in step (a), preferably to achieve a residual content of approx. 0.2-0.3%; (c) introduction of the product stream obtained in step (b) into a second reactor at 150-240°/15-100 bar and a catalytic gaseous phase hydrogenation to obtain optionally alkyl-substituted 1,4-butanediol; (d) separation of the desired product from the intermediate products, byproducts and, optionally, the non-converted educt; (e) optional return of the non-converted intermediate products to one or both hydrogenation stages. The hydrogenation catalyst, comprising CuO and an oxidic support, is used in both hydrogenation stages and in the second reactor a higher pressure prevails than in the first reactor.

REFERENCE COUNT: 4 THERE ARE 4 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 10 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2003:719445 HCAPLUS Full-text

DOCUMENT NUMBER: 139:230613

TITLE: Method for the simultaneous production of tetrahydrofurans and pyrrolidones

INVENTOR(S): Fischer, Rolf-Hartmuth; Roesch, Markus; Bottke, Nils; Weck, Alexander; Windecker, Gunther; Hesse, Michael; Borchert, Holger; Schlitter, Stephan

PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 29 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

## PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 2003074482	A1	20030912	WO 2003-EP2048	20030228
W:	AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW			
RW:	GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG			
DE 10209633	A1	20030911	DE 2002-10209633	20020302
AU 2003227027	A1	20030916	AU 2003-227027	20030228
EP 1483238	A1	20041208	EP 2003-743348	20030228
EP 1483238	B1	20070627		
R:	AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR, BG, CZ, EE, HU, SK			

CN 1639118	A	20050713	CN 2003-805107	20030228
JP 2005530700	T	20051013	JP 2003-572952	20030228
AT 365712	T	20070715	AT 2003-743348	20030228
US 2005119494	A1	20050602	US 2004-505706	20040826
US 7193091	B2	20070320		

PRIORITY APPLN. INFO.:

DE 2002-10209633	A	20020302
WO 2003-EP2048	W	20030228

OTHER SOURCE(S): CASREACT 139:230613

AB A method for the simultaneous production of optionally alkyl-substituted tetrahydrofurans and pyrrolidones comprises the gas-phase catalytic hydrogenation of C4 dicarboxylic acids and/or derivs. thereof in the presence of copper-containing catalysts and the reaction of  $\gamma$ -butyrolactone (I) with ammonia or primary amines to give pyrrolidones, whereby the C4 dicarboxylic acid derivs. are hydrogenated in the gas phase at 200 to 300 °C, 0.1 to 100 bar. Catalytic loadings are 0.01 to 1 kg starting material/L catalyst.hour and starting material/hydrogen mol. ratios of 20 to 800 in the presence of catalysts comprising copper, aluminum and/or zinc to give mixts. of THF and I, the product from hydrogenation is separated by distillation into a THF/water mixture as top product and a bottom product comprising I, the THF/water mixture from the second step is separated in a distillation arrangement comprising three columns. Water is drawn off from the bottom of the first column, THF containing water is recycled from the second column to the first column, a side stream from the first column is fed to the second column, the bottom product from the third column is recycled to the first column. A distillate is taken from the head of the first column, a side discharge from the second column is fed to the third column and the pure THF is obtained as the top product from the third column, I is obtained from the I-containing bottom product from the second step by distillation and the I thus obtained is reacted with ammonia or amines to give pyrrolidones.

REFERENCE COUNT: 4 THERE ARE 4 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 11 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2002:446013 HCAPLUS Full-text

DOCUMENT NUMBER: 137:34773

TITLE: Procedure for the gas-phase hydrogenation of C4 dicarboxylic acids or their derivatives in a fluidized-bed reactor into

$\gamma$ -butyrolactone and tetrahydrofuran  
INVENTOR(S): Borchert, Holger; Schlitter, Stephan;  
Hesse, Michael; Stein, Frank; Fischer,  
Rolf-Hartmuth; Rahn, Ralf-Thomas; Weck,  
Alexander; Roesch, Markus

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: Ger. Offen., 6 pp.

CODEN: GWXXBX

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
-----	----	-----	-----	-----
DE 10061558	A1	20020613	DE 2000-10061558	20001211
WO 2002048130	A1	20020620	WO 2001-EP14395	20011207
W: CN, JP, KR, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR				
EP 1349845	A1	20031008	EP 2001-984810	20011207
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT,				

IE, FI, CY, TR  
 JP 2004525093 T 20040819 JP 2002-549661 20011207  
 US 2004044230 A1 20040304 US 2003-450114 20030611  
 US 6958404 B2 20051025  
 PRIORITY APPLN. INFO.: DE 2000-10061558 A 20001211  
 WO 2001-EP14395 W 20011207  
 AB A procedure for the hydrogenation of C4 dicarboxylic acids or their derivs.  
 (e.g., maleic anhydride) in the gas phase and in a fluidized bed reactor into  
 γ-butyrolactone and THF is described. Known catalyst compns. may be used.

L52 ANSWER 12 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2002:446012 HCAPLUS Full-text  
 DOCUMENT NUMBER: 137:21776  
 TITLE: Procedures for the hydrogenation of maleic  
 anhydride and its derivatives in two connected series  
 reaction zones  
 INVENTOR(S): Borchert, Holger; Schlitter, Stephan;  
 Fischer, Rolf-Hartmuth; Roesch, Markus; Stein, Frank;  
 Rahn, Ralf-Thomas; Weck, Alexander; Kaibel,  
 Gerd  
 PATENT ASSIGNEE(S): BASF A.-G., Germany  
 SOURCE: Ger. Offen., 6 pp.  
 CODEN: GWXXBX  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 10061557	A1	20020613	DE 2000-10061557	20001211
WO 2002048129	A1	20020620	WO 2001-EP14393	20011207
W: CN, JP, KR, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR				
EP 1349844	A1	20031008	EP 2001-984809	20011207
EP 1349844	B1	20040811		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI, CY, TR				
JP 2004515546	T	20040527	JP 2002-549660	20011207
AT 273292	T	20040815	AT 2001-984809	20011207
ES 2223933	T3	20050301	ES 2001-1984809	20011207
US 2004034240	A1	20040219	US 2003-433424	20030604
US 6831182	B2	20041214		

PRIORITY APPLN. INFO.: DE 2000-10061557 A 20001211  
 WO 2001-EP14393 W 20011207  
 AB The gas-phase hydrogenation of C4 dicarboxylic acids and/or their derivs.  
 (e.g., maleic anhydride) for (un)substituted γ-butyrolactones and/or THF using  
 uses as a catalyst supported copper oxide and is conducted in a first reaction  
 zone, in which the C4 dicarbonylic acids and/or their derivs. are converted  
 into a mainly (un)substituted γ-butyrolactone-containing mixture, and in the  
 second reaction zone the γ-butyrolactone in the mixture from the first  
 hydrogenation stage is hydrogenated at a temperature which is lower than the  
 temperature in the first hydrogenation stage, into (un)substituted THF.

L52 ANSWER 13 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 2002:446011 HCAPLUS Full-text

DOCUMENT NUMBER: 137:34772  
 TITLE: Production of tetrahydrofuran by catalytic gas-phase hydrogenation of maleic anhydride  
 INVENTOR(S): Fischer, Rolf-Hartmuth; Stein, Frank; Pinkos, Rolf; Hesse, Michael; Sprague, Michael; Jolyon; Roesch, Markus; Borchert, Holger; Schlitter, Stephan; Rahn, Ralf-Thomas; Weck, Alexander  
 PATENT ASSIGNEE(S): BASF A.-G., Germany  
 SOURCE: Ger. Offen., 10 pp.  
 CODEN: GWXXBX  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 10061556	A1	20020613	DE 2000-10061556	20001211
WO 2002048128	A2	20020620	WO 2001-EP14394	20011207
WO 2002048128	A3	20020815		
W: CN, JP, KR, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR				
EP 1343743	A2	20030917	EP 2001-985854	20011207
EP 1343743	B1	20040922		
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR				
JP 2004525092	T	20040819	JP 2002-549659	20011207
AT 276986	T	20041015	AT 2001-985854	20011207
ES 2227309	T3	20050401	ES 2001-1985854	20011207
US 2004039214	A1	20040226	US 2003-433425	20030604
US 6730800	B2	20040504		

PRIORITY APPLN. INFO.: DE 2000-10061556 A 20001211  
 WO 2001-EP14394 W 20011207

AB Production of THF or alkyl-substituted THF is carried out by gas-phase hydrogenation of C4-dicarboxylic acids or their derivs. in the presence of catalysts containing < 80% of CuO and > 20% of other oxides as carriers. Maleic anhydride or maleic anhydride-containing products of hydrocarbon oxidation may be used as starting materials in THF production. The process is carried out at 240-310° and catalyst loads from 0.01 to 1.0 kg of starting materials per l of catalyst per h. Thus, a catalyst containing 50% CuO and 50% Al<sub>2</sub>O<sub>3</sub> (400 g) was prepared, mixed with graphite powder (12 g), and activated at 180° in the presence of hydrogen-nitrogen gas mixture. This catalyst was used for hydrogenation of the products of oxidation of n-butane extracted with di-Bu phthalate and comprising mainly maleic anhydride and traces of acrylic acid, acetic acid and extraction solvent. THF with 99.96% purity was isolated after fractional distillation of the hydrogenation products.

L52 ANSWER 14 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 2001:813999 HCAPLUS Full-text

DOCUMENT NUMBER: 135:346136

TITLE: Procedure for distillative separation of mixtures containing tetrahydrofuran,  $\gamma$ -butyrolactone, and/or 1,4-butanediol

INVENTOR(S): Kaibel, Gerd; Weck, Alexander; Rahn, Ralf-Thomas

PATENT ASSIGNEE(S): Basf A.-G., Germany

SOURCE: Ger. Offen., 22 pp.  
 CODEN: GWXXBX  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 10021703	A1	20011108	DE 2000-10021703	20000504
WO 2001085708	A1	20011115	WO 2001-EP4974	20010503
W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW				
RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG				
EP 1280787	A1	20030205	EP 2001-951476	20010503
R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, SI, LT, LV, FI, RO, MK, CY, AL, TR				
BR 2001010477	A	20030401	BR 2001-10477	20010503
JP 2003532720	T	20031105	JP 2001-582309	20010503
TW 527353	B	20030411	TW 2001-90110755	20010504
MX 2002PA10530	A	20030310	MX 2002-PA10530	20021025
US 2003106786	A1	20030612	US 2002-258938	20021029
US 6846389	B2	20050125		

PRIORITY APPLN. INFO.: DE 2000-10021703 A 20000504  
 WO 2001-EP4974 W 20010503

AB A procedure is disclosed for continuous distillative separation of mixts. containing THF,  $\gamma$ -butyrolactone, and/or 1,4-butanediol to  $\geq 3$  fractions. The mixts. result from hydrogenation of maleic anhydride, maleic acid, and its esters. Separation is carried out in a system of distillation columns which contains  $\geq 1$  column with a separation wall internal structure or  $\geq 1$  set of thermally coupled conventional distillation columns.

L52 ANSWER 15 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN  
 ACCESSION NUMBER: 1999:708724 HCAPLUS Full-text  
 DOCUMENT NUMBER: 131:323036  
 TITLE: Production of 1,4-butanediol  
 INVENTOR(S): Fischer, Rolf; Kaibel, Gerd; Pinkos, Rolf;  
 Rahn, Ralf-Thomas  
 PATENT ASSIGNEE(S): Basf Aktiengesellschaft, Germany  
 SOURCE: PCT Int. Appl., 23 pp.  
 CODEN: PIXXD2  
 DOCUMENT TYPE: Patent  
 LANGUAGE: German  
 FAMILY ACC. NUM. COUNT: 1  
 PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9955659	A1	19991104	WO 1999-EP2587	19990416
W: CA, CN, JP, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19818248	A1	19991028	DE 1998-19818248	19980423

TW 223649	B	20041111	TW 1999-88106020	19990415
CA 2329477	A1	19991104	CA 1999-2329477	19990416
EP 1073620	A1	20010207	EP 1999-920693	19990416
EP 1073620	B1	20030709		
R: BE, CH, DE, FR, GB, IT, LI, NL				
JP 2002512996	T	20020508	JP 2000-545820	19990416
MX 2000PA09664	A	20010316	MX 2000-PA9664	20001002
US 6350924	B1	20020226	US 2000-673134	20001011
PRIORITY APPLN. INFO.:			DE 1998-19818248	A 19980423
			WO 1999-EP2587	W 19990416

AB Butanediol (and possibly  $\gamma$ -butyrolactone and THF) is obtained by oxidizing butane or benzene to produce a product containing maleic anhydride (MA), absorption of the MA from the product stream by means of an inert, high-boiling solvent in an absorption stage, which yields a liquid absorption product, and esterification of this liquid MA absorption product with a C1-5 alc. in an esterification step, yielding an esterification product containing the corresponding maleate diester and high-boiling inert solvent. This is followed by hydrogenation/hydrogenolysis of the esterification product, which results in a product containing 1,4-butanediol and optionally  $\gamma$ -butyrolactone and THF as well as C1-5 alc. This product is separated by distillation and the alc. is returned to the esterification zone. Prior to hydrogenation /hydrogenolysis the esterification product is separated by distillation under reduced pressure into the diester and the inert solvent, the inert solvent is returned to the absorption stage, and the diester is hydrogenated in the liquid phase on a fixed-bed catalyst. An example is given in which di-Me maleate is hydrogenated /hydrogenolyzed in the liquid phase at 250 bar to give 98% butanediol; in the gas phase at 62 bar the yield is 79%.

REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 16 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1999:708720 HCAPLUS Full-text

DOCUMENT NUMBER: 131:323034

TITLE: Production of mixtures of 1,4-butanediol, tetrahydrofuran and  $\gamma$ -butyrolactone

INVENTOR(S): Fischer, Rolf; Kaibel, Gerd; Pinkos, Rolf; Rahn, Ralf-Thomas

PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 21 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
-----	---	-----	-----	-----
WO 9955654	A1	19991104	WO 1999-EP2685	19990421
W: CA, CN, JP, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19818340	A1	19991028	DE 1998-19818340	19980423
CA 2329353	A1	19991104	CA 1999-2329353	19990421
EP 1080061	A1	20010307	EP 1999-920726	19990421
EP 1080061	B1	20030618		
R: BE, DE, FR, GB, IT, NL				
JP 2002512993	T	20020508	JP 2000-545815	19990421
TW 518320	B	20030121	TW 1999-88106436	19990422
MX 2000PA10272	A	20010710	MX 2000-PA10272	20001020



US 6433192 B1 20020813 US 2001-673847 20010604  
 PRIORITY APPLN. INFO.: DE 1998-19818340 A 19980423  
 WO 1999-EP2685 W 19990421

AB Mixts. of butanediol, THF and  $\gamma$ -butyrolactone are obtained by oxidation of butane to a product containing maleic anhydride (MA), absorption of the MA from the product stream with a high-boiling alc., which yields a liquid absorption product containing maleic acid mono- and diesters and high-boiling alc., post-esterification of the liquid absorption product and subsequent hydrogenation/hydrogenolysis of the post-esterified product in the liquid phase. The high-boiling alc. is a polyvalent alc. with a b.p. at normal pressure of  $>233^{\circ}\text{C}$  and the post-esterified product has an acid value of  $<30$  mg KOH/g and a water content of  $<1$  weight%; the post-esterification is carried out at  $160\text{--}300^{\circ}$ . Examples are given using 1,6-hexanediol and 1,4-cyclohexanedimethanol as the polyvalent alcs. A temperature of  $150^{\circ}$  in the post-esterification led to a colored product and hydrogenation/hydrogenolysis catalyst deactivation.

REFERENCE COUNT: 1 THERE ARE 1 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 17 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1999:576894 HCAPLUS Full-text

DOCUMENT NUMBER: 131:185367

TITLE: Method for the purification of 1,4-butanediols obtained from the hydrogenation of maleic acid derivatives by distillation in the presence of compounds which act as alkalis

INVENTOR(S): Pinkos, Rolf; Fischer, Rolf; Liang, Shelue

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: PCT Int. Appl., 13 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9944975	A1	19990910	WO 1999-EP1250	19990226
W: CA, CN, IN, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19809493	A1	19990909	DE 1998-19809493	19980305
CA 2322746	A1	19990910	CA 1999-2322746	19990226
EP 1060155	A1	20001220	EP 1999-910290	19990226
EP 1060155	B1	20030521		
R: BE, DE, ES, FR, GB, IT				
CN 1132806	B	20031231	CN 1999-803690	19990226
ES 2200506	T3	20040301	ES 1999-910290	19990226
MX 2000PA08419	A	20010328	MX 2000-PA8419	20000828
US 6387224	B1	20020514	US 2000-623109	20000829

PRIORITY APPLN. INFO.: DE 1998-19809493 A 19980305  
 WO 1999-EP1250 W 19990226

AB A method is presented for separating a mixture containing butane-1,4-diol and at least one other compound from the following group: 4-hydroxybutyraldehyde, its cyclical hemiacetal and its cyclical whole acetals with at least one other alc., by distillation. The distillation is carried out in the presence of a compound which acts as an alkali. The mixture to be separated preferably contains a cyclical whole acetal of 4-hydroxybutyraldehyde with the other alc., this alc. having a lower boiling temperature than butanediol and being in free form. The method is especially suitable for distilling and separating

mixts. produced from the hydrogenation of maleic acid derivs. (e.g., di-Me maleate).

REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 18 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1999:529120 HCAPLUS Full-text

DOCUMENT NUMBER: 131:144965

TITLE: Absorptive method for separating and purifying maleic anhydride from maleic anhydride-containing hydrocarbon-oxidation stream mixtures by stripping

INVENTOR(S): Pinkos, Rolf; Rahn, Ralf-Thomas

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: PCT Int. Appl., 20 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9941223	A1	19990819	WO 1999-EP900	19990211
W: CA, CN, IN, KR, MX, US				
RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19806038	A1	19990819	DE 1998-19806038	19980213
CA 2318114	A1	19990819	CA 1999-2318114	19990211
EP 1056708	A1	20001206	EP 1999-907539	19990211
EP 1056708	B1	20011121		
R: BE, DE, ES, FR, GB, IT, NL				
ES 2168852	T3	20020616	ES 1999-907539	19990211
US 6329532	B1	20011211	US 2000-622172	20000814
PRIORITY APPLN. INFO.:				
			DE 1998-19806038	A 19980213
			WO 1999-EP900	W 19990211

AB Maleic anhydride is separated from maleic anhydride-containing reactor waste gases (resulting from maleic anhydride production by C4 hydrocarbon oxidation) by contacting the gas stream with a high-boiling inert absorption agent for maleic anhydride (e.g., di-Me phthalate) and the maleic anhydride is separated from the resulting liquid adsorbate phase by steam stripping. An alc. (e.g., methanol) is used as the desorption agent and maleic anhydride at least partly reacts with the alc. to yield a mono- and diester.

REFERENCE COUNT: 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 19 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1998:239184 HCAPLUS Full-text

DOCUMENT NUMBER: 128:283144

TITLE: Process and catalysts for preparing 1,4-butanediol by the hydrogenation of 1,4-butyndiol

INVENTOR(S): Becker, Rainer; Brocker, Franz Josef; Kaibel, Gerd;

Pinkos, Rolf; Wulff-Doring, Joachim

PATENT ASSIGNEE(S): BASF Aktiengesellschaft, Germany

SOURCE: PCT Int. Appl., 28 pp.

CODEN: PIXXD2

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

## PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
WO 9815513	A1	19980416	WO 1997-EP5205	19970923
W: CA, CN, JP, KR, US				
RW: AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
DE 19641707	A1	19980416	DE 1996-19641707	19961010
CA 2260810	A1	19980416	CA 1997-2260810	19970923
CA 2260810	C	20050510		
CN 1222902	A	19990714	CN 1997-195779	19970923
CN 1097574	B	20030101		
EP 934239	A1	19990811	EP 1997-943884	19970923
EP 934239	B1	20020102		
R: BE, DE, ES, FR, GB, IT, NL				
JP 2001501631	T	20010206	JP 1998-517125	19970923
ES 2170416	T3	20020801	ES 1997-943884	19970923
TW 379214	B	20000111	TW 1997-86114480	19971003
KR 2000048993	A	20000725	KR 1999-703051	19990409
US 6262317	B1	20010717	US 1999-284209	19990409
PRIORITY APPLN. INFO.:				
			DE 1996-19641707	A 19961010
			WO 1997-EP5205	W 19970923

AB In the title process, 1,4-butanediol is reacted with hydrogen in the liquid continuous phase in the presence of a heterogeneous hydrogenation catalyst at 20-300°/1-200 bar and a liquid-side mass transfer coefficient,  $k_L a$ , relative to the volume, of 0.1-1 s<sup>-1</sup>, with: (a) the supported, transition-metal catalyst suspended in the reaction medium so that when a packed bubble column is used it is operated in the upwards mode and at a ratio of the amount of gas leaving the reaction vessel to the amount fed to it of 0.4-0.99:1; or (b) is guided upwards in parallel flow through a fixed-bed reactor operated in a circulating gas mode with the ratio between the amount of gas fed to the reaction vessel and the amount of gas leaving it being maintained 0.4-0.99:1. Process flow diagrams are presented.

REFERENCE COUNT: 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD. ALL CITATIONS AVAILABLE IN THE RE FORMAT

L52 ANSWER 20 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1995:422843 HCAPLUS Full-text

DOCUMENT NUMBER: 122:264899

TITLE: Preparation of 1,4-butanediol from 2,5-dihydrofuran.

INVENTOR(S): Pinkos, Rolf; Fischer, Rolf; Breitscheidel, Boris; Polanek, Peter

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: Ger. Offen., 7 pp.

CODEN: GWXXBX

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

## PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
DE 4325753	A1	19950202	DE 1993-4325753	19930731
CA 2168458	A1	19950209	CA 1994-2168458	19940707
CA 2168458	C	20040525		
WO 9504023	A1	19950209	WO 1994-EP2232	19940707
W: AU, BR, BY, CA, CN, CZ, FI, HU, JP, KR, KZ, NO, NZ, PL, RU, UA, US				
RW: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
AU 9473847	A	19950228	AU 1994-73847	19940707

EP 711267	A1	19960515	EP 1994-923711	19940707
EP 711267	B1	19971015		
R: AT, BE, CH, DE, ES, FR, GB, IT, LI, NL, SE				
CN 1128017	A	19960731	CN 1994-192959	19940707
CN 1066702	B	20010606		
JP 09500877	T	19970128	JP 1995-505520	19940707
JP 3616642	B2	20050202		
AT 159237	T	19971115	AT 1994-923711	19940707
ES 2107852	T3	19971201	ES 1994-923711	19940707
RU 2119905	C1	19981010	RU 1996-108796	19940707
FI 9600429	A	19960130	FI 1996-429	19960130
FI 111458	B1	20030731		

## PRIORITY APPLN. INFO.:

DE 1993-4325753	A	19930731
WO 1994-EP2232	W	19940707

OTHER SOURCE(S): CASREACT 122:264899

AB HO(CH<sub>2</sub>)<sub>4</sub>OH (I) was prepared in a single step by reaction of 2,5-dihydrofuran (II) with H<sub>2</sub>O and H at 20-300° and 1-300 bar using a hydrogenation catalyst. Thus, a mixture of II, 1,4-dioxane, and H<sub>2</sub>O was introduced to a tube reactor packed with 6% Re on TiO<sub>2</sub> and maintained at 154° and 120 bar H to give a product mixture consisting of I 85, THF 6, γ-butyrolactone 3, 4-hydroxybutanal 1, and BuOH 5 weight % at 100% conversion.

L52 ANSWER 21 OF 21 HCAPLUS COPYRIGHT 2007 ACS on STN

ACCESSION NUMBER: 1994:57168 HCAPLUS Full-text

DOCUMENT NUMBER: 120:57168

TITLE: Separation of 1,4-butanediol from hydrogenation products

INVENTOR(S): Gosch, Hans Juergen; Rust, Harald; Fischer, Rolf; Hechler, Claus; Pinkos, Rolf

PATENT ASSIGNEE(S): BASF A.-G., Germany

SOURCE: Ger. Offen., 4 pp.

CODEN: GWXXBX

DOCUMENT TYPE: Patent

LANGUAGE: German

FAMILY ACC. NUM. COUNT: 1

## PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
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DE 4205471	A1	19930826	DE 1992-4205471	19920222
JP 05286876	A	19931102	JP 1993-8741	19930122
JP 3358839	B2	20021224		
EP 557786	A1	19930901	EP 1993-101992	19930209
EP 557786	B1	19960508		
R: AT, BE, CH, DE, ES, FR, GB, IT, LI, NL, SE				
AT 137730	T	19960515	AT 1993-101992	19930209
ES 2086142	T3	19960616	ES 1993-101992	19930209
US 5342488	A	19940830	US 1993-18496	19930217

## PRIORITY APPLN. INFO.:

DE 1992-4205471	A	19920222
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AB 1,4-Butanediol (I) is separated from products of the hydrogenation of maleate, fumarate, or succinate esters by distilling alcs., H<sub>2</sub>O, and THF in a 20-70-plate column at head temperature and pressure 40-120°/50-1100 mbar, distilling the bottoms in a 30-90-plate column at head temperature 45-120°/45-250 mbar to remove alcs., butyrate esters, and butyrolactone, separating the bottoms into a heavy and light phase, recycling the upper succinate diester phase to the phase separator, distilling the I-rich bottom phase in a 30-90 plate column at head temperature 45-120°/45-250 mbar, separating the I-butyrate ester azeotrope and recycling it to the phase separator, and removing bottoms

containing I, alkyl hydroxyalkyl succinates, hydroxyalkyl butyrates, and high-boiling compds.

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(FILE 'HOME' ENTERED AT 10:04:31 ON 25 SEP 2007)

FILE 'REGISTRY' ENTERED AT 10:04:37 ON 25 SEP 2007

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L1      167 SEA ABB=ON  PLU=ON  C4H10O2/MF
L2      90 SEA ABB=ON  PLU=ON  L1 AND ?DIOL?/CNS
      E BUTANEDIOL/CN
L3      1 SEA ABB=ON  PLU=ON  BUTANEDIOL/CN
L4      90 SEA ABB=ON  PLU=ON  L2 OR L3
      SEL RN
L5      23645 SEA ABB=ON  PLU=ON  (101021-58-3/CRN OR 101021-60-7/CRN OR
      107-88-0/CRN OR 110-63-4/CRN OR 110-71-4/CRN OR 114794-46-6/CRN
      OR 117373-32-7/CRN OR 117373-33-8/CRN OR 119567-52-1/CRN OR
      119567-53-2/CRN OR 127032-47-7/CRN OR 127032-49-9/CRN OR
      136707-56-7/CRN OR 136779-42-5/CRN OR 138885-86-6/CRN OR
      144831-21-0/CRN OR 14848-89-6/CRN OR 159806-32-3/CRN OR
      160961-49-9/CRN OR 168011-04-9/CRN OR 179679-50-6/CRN OR
      179913-51-0/CRN OR 19132-06-0/CRN OR 2163-42-0/CRN OR 219473-96
      -8/CRN OR 219473-97-9/CRN OR 219925-61-8/CRN OR 23554-34-9/CRN
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      1/CRN OR 41240-66-8/CRN OR 43044-32-2/CRN OR 495384-83-3/CRN
      OR 50410-66-7/CRN OR 513-85-9/CRN OR 5341-95-7/CRN OR 554429-16
      -2/CRN OR 558-43-0/CRN OR 584-03-2/CRN OR 58735-88-9/CRN OR
      62064-81-7/CRN OR 6290-03-5/CRN OR 67057-67-4/CRN OR 67057-69-6
      /CRN OR 68344-06-9/CRN OR 68972-45-2/CRN OR 6982-25-8/CRN OR
      70969-15-2/CRN OR 71760-76-4/CRN OR 71764-39-1/CRN OR 72271-58-
      0/CRN OR 73522-17-5/CRN OR 74829-49-5/CRN OR 75156-26-2/CRN OR
      76490-88-5/CRN OR 79562-77-9/CRN OR 79562-82-6/CRN OR 79864-96-
      3/CRN OR 799775-81-8/CRN OR 80404-89-3/CRN OR 80902-18-7/CRN
      OR 84803-08-7/CRN OR 84803-09-8/CRN OR 84868-09-7/CRN OR
      84868-10-0/CRN OR 86688-15-5/CRN OR 871313-10-9/CRN OR
      87876-53-7/CRN OR 87876-58-2/CRN OR 87876-59-3/CRN OR 89268-43-
      9/CRN OR 91314-21-5/CRN OR 942519-61-1/CRN OR 97825-34-8/CRN
      OR 99441-00-6/CRN OR 99801-86-2/CRN) OR L4
      E BUTYROLACETONE/CN
      E BUTYROL ACETONE/CN
      E GBL/CN
L6      2 SEA ABB=ON  PLU=ON  GBL/CN
      D TOT
      E BDO/CN
L7      1 SEA ABB=ON  PLU=ON  ACETONE/CN
      D
      E BUTYROL/CN
L8      2 SEA ABB=ON  PLU=ON  BUTYROL/CN
      D TOT

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FILE 'CAPLUS' ENTERED AT 10:08:46 ON 25 SEP 2007

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      E US2006-581074/APPS
L9      2 SEA ABB=ON  PLU=ON  US2006-581074/AP

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SEL RN

FILE 'REGISTRY' ENTERED AT 10:09:01 ON 25 SEP 2007

L10 25 SEA ABB=ON PLU=ON (1344-28-1/BI OR 108-30-5/BI OR 109-99-9/BI  
OR 110-16-7/BI OR 1304-28-5/BI OR 1305-78-8/BI OR 1306-38-3/BI  
OR 1309-48-4/BI OR 1312-81-8/BI OR 1314-11-0/BI OR 1314-13-2/B  
I OR 1314-23-4/BI OR 1317-34-6/BI OR 1317-38-0/BI OR 1333-74-0/  
BI OR 13463-67-7/BI OR 14635-75-7/BI OR 25265-75-2/BI OR  
67-66-3/BI OR 7440-44-0/BI OR 7631-86-9/BI OR 7732-18-5/BI OR  
9016-00-6/BI OR 9052-19-1/BI OR 96-48-0/BI)

L11 1 SEA ABB=ON PLU=ON L10 AND L6  
D  
SEL RN

L12 314 SEA ABB=ON PLU=ON 96-48-0/CRN OR L11  
E TETRAHYDROFURAN/CN

L13 1 SEA ABB=ON PLU=ON TETRAHYDROFURAN/CN  
SEL RN

L14 8024 SEA ABB=ON PLU=ON L13 OR 109-99-9/CRN  
D L13

L\*\*\* DEL 0 S C4H8O/CN

L15 353 SEA ABB=ON PLU=ON C4H8O/MF

L16 18 SEA ABB=ON PLU=ON L15 AND OC4/ES  
SEL RN

L17 8063 SEA ABB=ON PLU=ON (109-99-9/CRN OR 120089-77-2/CRN OR  
135008-66-1/CRN OR 153172-62-4/CRN OR 1693-74-9/CRN OR  
20665-63-8/CRN OR 243855-45-0/CRN OR 2717-68-2/CRN OR 34475-13-  
3/CRN OR 68383-93-7/CRN OR 70969-13-0/CRN OR 758674-46-3/CRN  
OR 775273-86-4/CRN OR 87174-62-7/CRN OR 87174-63-8/CRN OR  
87174-64-9/CRN OR 89268-44-0/CRN OR 97807-15-3/CRN) OR L16

L18 8063 SEA ABB=ON PLU=ON L17 OR L14

L19 0 SEA ABB=ON PLU=ON L5 AND L12 AND L18

FILE 'CAPLUS' ENTERED AT 10:12:30 ON 25 SEP 2007

L20 521 SEA ABB=ON PLU=ON L5 AND L12 AND L18

L21 1 SEA ABB=ON PLU=ON L20 AND L9  
D IALL L9 TOT

L22 217 SEA ABB=ON PLU=ON L20 AND PREP+NT/RL  
E HYDROGENATION+ALL/CT

FILE 'HCAPLUS' ENTERED AT 10:15:32 ON 25 SEP 2007

L23 54460 SEA ABB=ON PLU=ON HYDROGENATION+PFT,NT/CT

L24 43408 SEA ABB=ON PLU=ON HYDROGENATION CATALYSTS+PFT,NT/CT

L25 108 SEA ABB=ON PLU=ON L22 AND ((L23 OR L24) OR ?HYDROGENAT?)

L26 9 SEA ABB=ON PLU=ON L25 AND ?DISTIL?

L27 1 SEA ABB=ON PLU=ON L26 AND L9

FILE 'REGISTRY' ENTERED AT 10:17:33 ON 25 SEP 2007

E SUCCINIC ANHYDRIDE/CN

L28 1 SEA ABB=ON PLU=ON "SUCCINIC ANHYDRIDE"/CN  
SEL RN

L29 2034 SEA ABB=ON PLU=ON L28 OR 108-30-5/CRN

FILE 'HCAPLUS' ENTERED AT 10:17:52 ON 25 SEP 2007

L30 36 SEA ABB=ON PLU=ON L25 AND (L29 OR SUCCINIC ANHYDRID?)

L31 35 SEA ABB=ON PLU=ON L30 AND ?CATAL?

L32 18 SEA ABB=ON PLU=ON L25 AND ?REACTOR?

L33 15 SEA ABB=ON PLU=ON L25 AND ?STREAM?

L34 2 SEA ABB=ON PLU=ON L32 AND L33

L35 10 SEA ABB=ON PLU=ON L31 AND (L32 OR L33)

L36 19 SEA ABB=ON PLU=ON L26 OR L34 OR L35

L37           E ROSCH M/AU  
           41 SEA ABB=ON PLU=ON ("ROSCH M"/AU OR "ROSCH M W"/AU OR "ROSCH  
               MARKUS"/AU)  
               E PINKOS R/AU  
 L38           121 SEA ABB=ON PLU=ON ("PINKOS ROLF"/AU OR "PINKOS ROLF DR"/AU)  
               E HESSE M/AU  
 L39           300 SEA ABB=ON PLU=ON ("HESSE M"/AU OR "HESSE M A"/AU OR "HESSE  
               M B"/AU OR "HESSE M D"/AU OR "HESSE M E"/AU OR "HESSE M G  
               L"/AU OR "HESSE MICHAEL"/AU)  
               E SCHLITTER S/AU  
 L40           33 SEA ABB=ON PLU=ON ("SCHLITTER STEPHAN"/AU OR "SCHLITTER  
               STEPHAN M"/AU)  
               E JUNICKE H/AU  
 L41           30 SEA ABB=ON PLU=ON ("JUNICKE H"/AU OR "JUNICKE HENRIK"/AU)  
               E SCHUBERT O/AU  
 L42           15 SEA ABB=ON PLU=ON ("SCHUBERT O"/AU OR "SCHUBERT O E"/AU OR  
               "SCHUBERT OLGA"/AU)  
               E WECK A/AU  
 L43           45 SEA ABB=ON PLU=ON ("WECK A"/AU OR "WECK A L DE"/AU OR "WECK  
               ALEXANDER"/AU)  
               E WINDECKER G/AU  
 L44           17 SEA ABB=ON PLU=ON ("WINDECKER G"/AU OR "WINDECKER GUNTHER"/AU  
               )  
 L45           524 SEA ABB=ON PLU=ON (L37 OR L38 OR L39 OR L40 OR L41 OR L42 OR  
               L43 OR L44)  
 L46           133 SEA ABB=ON PLU=ON L45 AND ?HYDROGENAT?  
 L47           43 SEA ABB=ON PLU=ON L46 AND (L5 OR L12 OR L18)  
 L48           8 SEA ABB=ON PLU=ON L47 AND ?DISTIL?  
 L49           42 SEA ABB=ON PLU=ON L47 AND (PREP+NT/RL OR PREPAR? OR SYNTH?)  
 L50           12 SEA ABB=ON PLU=ON L49 AND REACTOR?  
 L51           7 SEA ABB=ON PLU=ON L49 AND ?STREAM?  
 L52           21 SEA ABB=ON PLU=ON L48 OR L50 OR L51

FILE 'HCAPLUS' ENTERED AT 10:30:36 ON 25 SEP 2007

D QUE L36  
 D L36 IBIB ABS HITIND HITSTR TOT  
 D QUE L52  
 D L52 IBIB ABS TOT